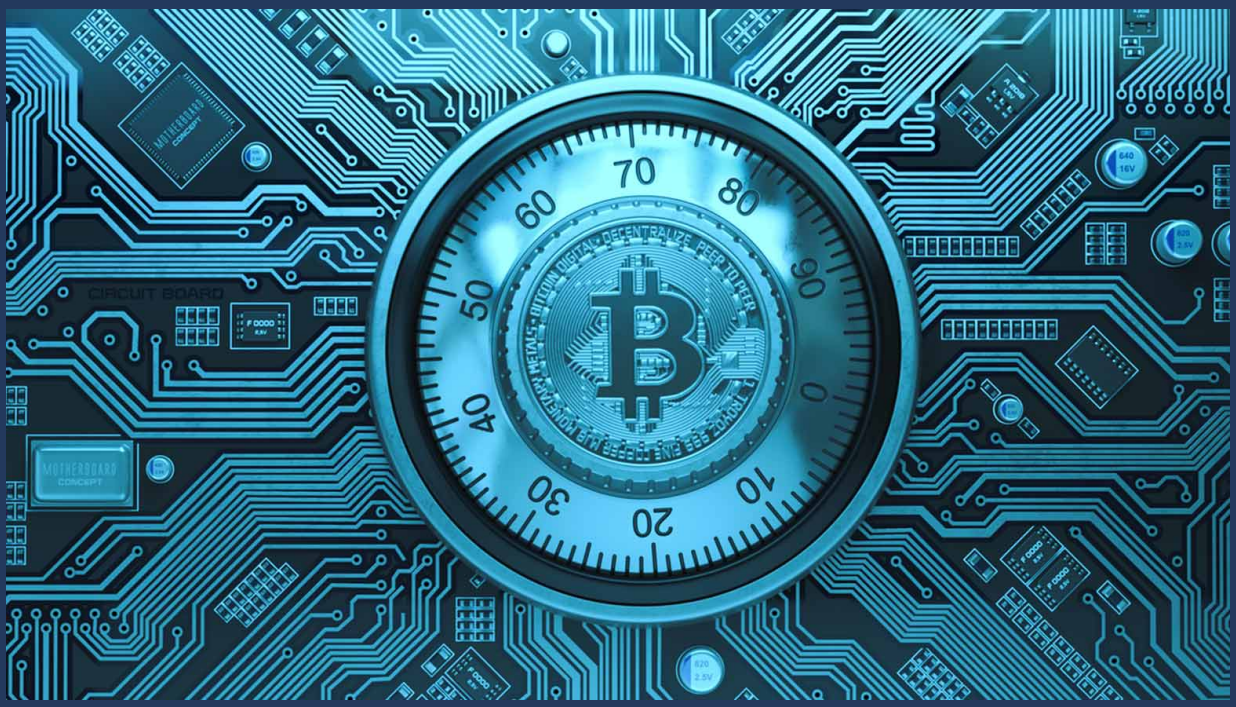
How to increase citizens' involvement in public participation using blockchain technologies?

Hubert Bratek



TU Delft

How to increase citizens' involvement in public participation using blockchain technologies?

Master Thesis

by

Hubert Bratek

to obtain the degree of Master of Science
at the Delft University of Technology
to be defended publicly on 14.07.2023

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Faculty of Technology, Policy and Management · Delft University of Technology

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Hubert Bratek,

Delft, July 2022

Executive Summary

Nowadays, more and more countries throughout the world try to strengthen cooperation with their citizens. Such teamwork is called public participation and even though it is known for many many years, its processes are still old-fashioned without the usage of new technologies and most of the countries, especially in Europe are failing to attract citizens to share their problems and opinions. Usage of the internet in a different way than having a website available for the citizens is exceptional, not to mention the usage of more advanced technologies like blockchain and non-fungible tokens (NFT), which are one of the newest concepts that are currently being analyzed and researched in the world.

However, public participation still has many problems. Starting with the one mentioned before, there is limited involvement of citizens. Currently used methods are usually time-consuming and lack digitalization. What is more, those methods do not incentivise people to share their problems and ideas, and there is a small amount of information on how to tackle the problems and challenges of current the approach. New technologies, starting with the Internet and moving to the more advanced ones could help in tackling this problem, yet the current understanding of its facilitation is still being questioned. Last but not least, there is still a limited understanding of any potential benefits and drawbacks of integrating such technologies with the municipality. The usage of those technologies might provide amazing advantages and solve multiple limitations of the existing solutions.

The main research question tries to tackle those knowledge gaps and answer the most important question: **What is the added value of an innovative blockchain and NFT approach on public participation in the local government decision-making process?**. To answer the research question, 4 smaller sub-research questions have been created, each one providing more information towards the result. The research scope is specified to the Delft region in the Netherlands, due to the different political regulations, as well as the proximity of the residence of the researcher. Mixed-method research is used to obtain the most viable results. First of all, interviews with government officials in Delft have been performed to understand and further evaluate public participation methods that are used in the municipality. Secondly, surveys with the citizens have been executed to obtain real-life information on the effects of those methods on the understanding and knowledge of people about any possibilities to share their problems in the city. Last but not least, in order to obtain as much as possible information about blockchain, interviews with its experts have been performed. There are multiple data sources available for analysing, providing the highest quality result possible.

The research explores the potential of these technologies to enhance citizen engagement, improve transparency, and increase trust in the decision-making processes of local government. Through a comprehensive research methodology, including literature reviews, interviews, and surveys, the study gathers insights from key stakeholders such as government officials, citizens, and blockchain and e-governance experts. The analysis of the data reveals valuable findings regarding the current state of public participation, the challenges faced by traditional methods, and the potential of blockchain and NFT technology to address these issues.

The research identifies a specific segment of citizens in the realm of public participation. In this case, the focus is on individuals residing in the city who are indirectly affected by city-wide decisions. By offering clearer guidance and enhancing understanding of city decisions for these individuals, their level of public participation can be influenced and increased. This approach aims to raise awareness among a wider audience that even seemingly irrelevant actions, such as road closures or school shutdowns in specific districts, have effects across multiple regions. Consequently, this increased relevance can enhance their motivation to participate.

The results demonstrate that the innovative approach of leveraging blockchain and NFT technology holds significant promise in enhancing public participation. By leveraging the decentralized and transparent nature of blockchain, it becomes possible to create tamper-proof records, secure information transfer and provide transparency in the process, making it impossible for the manipulation in any voting platforms that

would be available using typical solutions. Additionally, the use of NFTs provides unique opportunities for incentivisation related to public participation.

However, while this research presents compelling insights, it also acknowledges the necessary need for further exploration and future research on the topic of blockchain and NFT. In order to start introducing those technologies in the city, many limitations have to be resolved. The implementation challenges of adopting blockchain and NFT technology in public participation require careful consideration, including research on the parties holding 51% of the network, regulatory frameworks, privacy and security, as well as environmental and technological issues like scalability, user interface and user experience (UI/UX) and huge energy consumption. The research provides the reflection on those findings and gives a clear direction of where more research could be done in every limitation found throughout the study. Future studies should delve deeper to provide practical recommendations for successful implementation and hopefully make the possibility of creating a blockchain-based platform for public participation.

Overall, this master's thesis contributes to the growing body of knowledge on enhancing public participation and e-governance through innovative approaches. By embracing the potential of blockchain and NFT technology, local governments can foster greater citizen engagement, transparency, and increased trust in decision-making processes. The findings of this research have practical implications for the key stakeholders in those topics like policymakers, government officials, and people involved in public participation initiatives.

It is recommended that policymakers and decision-makers actively consider the findings of this study to evaluate the shape of future strategies and policies in public participation. Understanding the possible use cases and limitations of the technology helps in utilizing it in the best possible way. By embracing the opportunities offered by innovative technologies, cities can pave the way for more inclusive and participatory governance, ultimately leading to better outcomes and stronger democratic processes.

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Introduction

Public participation is an important aspect of current democratic societies, providing citizens with the opportunity to engage and participate in decision-making processes. However, traditional methods of public participation have been associated with low levels of citizen engagement (Innes & Booher, 2000). The emergence of new technologies, e-governance and even ideas based on blockchain, non-fungible tokens (NFTs) and decentralized autonomous organizations (DAOs), provides an opportunity to increase citizen participation in governance (Abodei, Norta, Azogu, Udokwu, & Draheim, 2019). These technologies offer new ways of engaging citizens in the decision-making process, improving transparency, and enhancing trust in the democratic process. This study aims to explore the potential of these new technologies to increase citizens' involvement in public participation, by analyzing their benefits and limitations and identifying the potential for their usage. By doing so, this study seeks to contribute to the development of effective strategies for increasing citizen participation in public decision-making using new technologies.

1.1. Research Background

In the current world, all different industries are becoming much more digitalized than before. Patients in the hospital can see their whole medical history while being logged in to their accounts (Luarasi, Durresi, & Durresi, 2013), people order their food from their smartphone application - like from Picnic (Picnic, 2023) and even reserve the car for as long as they need within several clicks on their phone - like MyWheels (MyWheels, 2023). While many industries are going forward and moving their servers and applications to the cloud and online world, several industries still lack such movement and adaptation by the users, especially when it comes to the new emergent technologies.

One of the examples is public participation in the cities and municipalities. Countries throughout Europe have a different approach to gathering information from their citizens. On the one hand, several cities in the Netherlands, such as Delft - usually, data is gathered by the District Police Officer who talks to the different people in his region. Usually, the people sharing the problems are shop owners, restaurant managers and community leaders, which might create a bias in the provided data. This information is further presented to the governors in the city, the problems are analysed and decisions on whether to tackle them or not are made. On the other hand, the Polish approach is completely different. When a new problem arises, people advocating for a change usually gather signatures in the city centre and create a petition. Only after obtaining enough votes and signatures (around 10000), the petition is sent to the president of the city with a request to react to the rising and crucial problem in the region.

One notable problem faced by many countries today is the lack of digitalization in the realm of public participation. In this era of emerging technologies, it is surprising that the digitalization of citizen engagement is not yet commonplace. Despite the growing popularity of digital technologies in our daily lives, the concept of digital public participation has not yet fully taken off in many parts of the world (OECD, 2019). A new concept called e-government is still in the process with multiple potential ideas and solutions for revolutionizing public participation, yet it still has a long way to go (Twizeyimana & Andersson, 2019). Multiple improvements that can be made through digitalization, require some changes in the policies, as well as within the processes that currently exist making the change harder and longer to introduce. For that reason, some governments continue to rely on traditional methods of public participation, which can be limiting and result in low citizen engagement. However, the use of already available technologies such

as social media and mobile applications and emerging ones such as blockchain, and non-fungible tokens (called NFTs) presents a new opportunity to increase citizens' involvement in public participation and a huge step towards the more advanced part in the e-government (Kassen, 2022). Therefore, it is essential to explore how new emerging technologies can be leveraged to foster greater citizen engagement in public participation and identify the challenges that may arise during their implementation. Among the last emerging technologies, one of them is distributed networks, called blockchain which have interesting capabilities for tackling multiple different problems through its immutability and transparency.

Blockchain is a distributed and decentralized system that can securely and transparently store and transfer data without the need for intermediaries. This technology has gained increasing attention in recent years due to its potential to revolutionize various sectors, including public participation. It is the technology that is a base for cryptocurrencies such as Bitcoin and Ethereum, but it has the potential to be used in a wide range of other applications as well (Nofer, Gomber, Hinz, & Schiereck, 2017). The core features of blockchain technology, such as transparency, immutability, and decentralization, offer opportunities to enhance citizen engagement and participation in decision-making processes. Blockchain can be used to create tamper-proof records of votes, enable the secure and transparent transfer of information between citizens and governments, and incentivize citizen participation through the use of tokens. Additionally, blockchain can enable the creation of smart contracts, which can automatically execute specific actions when predefined conditions are met. These features offer promising solutions to some of the challenges faced by traditional public participation methods, such as lack of trust, transparency, and participation. Despite the potential benefits of blockchain in public participation, the technology is still relatively new, and its implementation in the context of public participation has to still be thoroughly explored. Therefore, this research aims to investigate the potential usage of blockchain technology in increasing citizens' involvement in public participation.

Another important concept related to blockchain technology is NFT. Non-Fungible Tokens (NFTs) are digital assets that are unique and cannot be replicated. NFTs are based on blockchain technology, which allows for the creation of secure and transparent digital ledgers. They have recently gained attention in the art world as a way to verify ownership and authenticity of digital art (Wang, Li, Wang, & Chen, 2021). Nowadays multiple platforms like OpenSea and Binance provide a way for people to buy NFT and obtain its digital ownership. Because NFTs are unique and verifiable, they open up new possibilities for creators and collectors in the digital realm. Collections such as *Mutant Ape Yacht Club* allow owners to talk to each other on private discord channels and meet together. As usual, the people owning the NFTs are celebrities, which allows normal people to further enhance their network and have direct access to talk with people like Snoop Dogg. However, NFTs have the potential to be used in various other applications, including public participation.

Overall, the potential of NFTs in public participation is an area that has yet to be fully explored. While there are some concerns about the environmental impact of NFTs and blockchain and the potential for them to exacerbate existing inequalities, the use of NFTs in public participation could offer a new way to incentivize and reward citizens for their engagement, ultimately leading to more effective decision-making processes and reduced participation problems in the city.

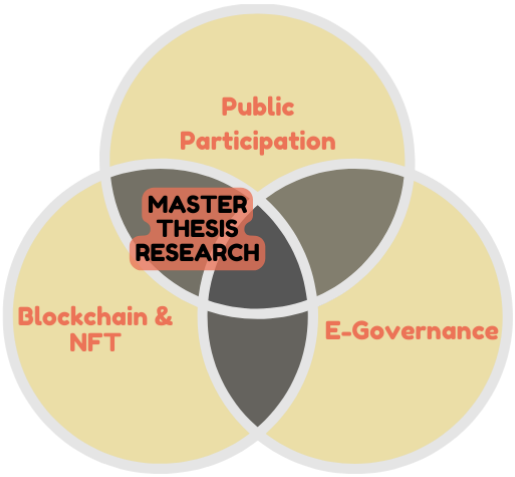

Figure 1.1: Research Background Diagram

1.2. Problem Identification

The problem identified in this study is the **limited involvement of citizens in public participation**. The traditional methods of public participation, such as town hall meetings and public forums, have not been successful in attracting a large number of citizens (Innes & Booher, 2000). Moreover, the current methods have limitations such as geographical constraints, limited reach, and lack of transparency. Therefore, there is a need to explore new approaches to increase citizen participation in public decision-making processes with the new technologies, improving the current status of e-governance, which nowadays focuses mostly on the internet as a whole. This research aims to identify how new emerging technologies such as blockchain and NFT can be leveraged to overcome the limitations of traditional public participation methods and increase citizen involvement in the decision-making process by utilizing the current knowledge about e-governance (Heeks, 2001).

While some cities actively encourage citizen engagement, others place little emphasis on it. In Delft, several strategies have been identified (Delft, 2020b). Firstly, social media platforms such as Facebook and Instagram are utilized to disseminate information about social policies and to gather opinions from residents. Different platforms are employed depending on the target audience. Secondly, digital communication channels have been established between citizens and the municipality for environmental initiatives, such as maintaining green spaces. Residents are encouraged to take part in these activities to improve their community (Delft, 2020a).

However, several challenges remain. The COVID-19 pandemic has created a pressing need for digital participation and connection. The use of digital platforms has made it easier to discover and participate in various initiatives. Nonetheless, the Delft municipality lacks statistical data on public participation, which could be obtained more easily through digital channels. Additionally, there is limited input opportunity for citizens, which could be improved through the use of digital platforms. It is worth noting that typical public participation digital platforms have their own drawbacks, as demonstrated by the Active Citizen App in Moscow (Holder, 2017). Citizens also find it difficult to trust a municipality that solely maintains a solution without any form of verification or protection to prevent tampering with people's decisions.

Furthermore, there is not enough research in e-governance about the use of those new technologies as an enhancement of public participation. This knowledge gap can be addressed through a comprehensive analysis of these technologies in the context of public participation. There is also a limited understanding of the potential benefits and drawbacks of using such solutions in cities. Many regulations may be too stringent to allow for the implementation of such solutions, and the costs of maintaining them may be prohibitively high. Further research is necessary to identify the necessary starting points for the use of blockchain technology in public participation.

1.2.1. Knowledge Gaps

The study of public participation using blockchain and NFT technologies is a relatively new field that has not yet been extensively researched. There have already been some articles presented within the context of e-governance. Yet there are still several knowledge gaps that need to be addressed. One such gap is the lack of understanding of how blockchain and NFT technologies can be used to increase citizen involvement in public participation. Additionally, there is a need for more research on how blockchain technology and NFTs can be used to facilitate public participation and increase citizen engagement in local government decision-making. Another knowledge gap is the limited understanding of the potential benefits and drawbacks of using blockchain technology and NFTs in public participation, such as the issues of security, scalability, interoperability and incentivisation. Finally, there is a necessity for more research to understand how blockchain technology and NFTs can be integrated and introduced with existing systems and processes in the local government to efficiently introduce the platform based on those technologies. This study aims to address these knowledge gaps by exploring the potential usage of blockchain and NFT technologies in public participation, identifying the potential challenges and limitations, and analysing the possible impact of these technologies on public participation and e-governance.

1. Small amount of information about how to further incentivise people and tackle the problem and challenges of the current methods for increasing the public engagement
2. Lack of understanding of how blockchain technology and NFTs can be used to facilitate public participation and increase citizen engagement in local government decision-making
3. Limited understanding of the potential benefits and drawbacks of using blockchain technology and NFTs in public participation, such as the issues of security, scalability, interoperability and incentivisation
4. Lack of understanding of how blockchain technology and NFTs can be integrated with existing systems and processes in the local government to efficiently introduce the platform based on those technologies

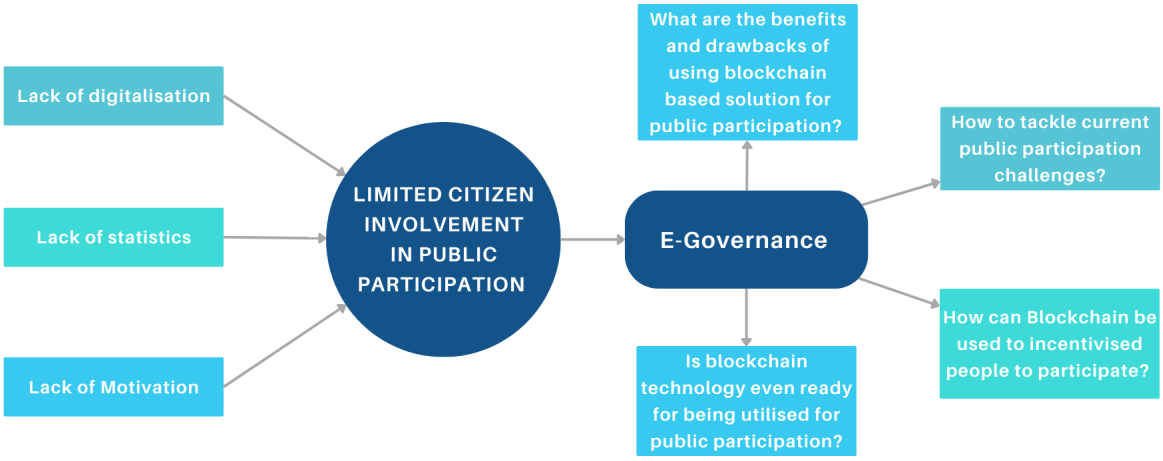

Figure 1.2: Problem Identification

1.2.2. Motivation and relevance

The motivation and relevance of this research lie in the potential benefits that can be achieved through increasing citizens' involvement in public participation. Public participation is an essential component of democratic societies, as it allows citizens to have a voice in decision-making processes that affect their lives. However, traditional public participation methods have several limitations, such as being time-consuming, costly, and having limited reach.

Emerging technologies such as blockchain and NFTs have the potential to address these limitations and increase citizens' engagement in public participation. However, there is a knowledge gap in how

these technologies can be effectively utilized in the context of public participation. This research aims to fill this gap by exploring the potential of blockchain and NFTs in increasing citizens' involvement in public participation.

What is more, there are multiple research papers on creating E-Governance in countries, which is transitioning from the paper world to the digital one. A huge technology push is seen in this area, where many new startups and ideas are created to further utilize new technologies for governance. There is also visible interest in the combination of Web3 platforms and real-life scenarios. Many startups try to combine the benefits of blockchain and NFT to introduce it in new areas, gaining the advantages of the first movers. Last but not least, many cities struggle with low levels of public participation in the decision-making process. As mentioned previously, in the US only around 10% of citizens participate in public meetings (Bureau, 2017).

Apart from that many personal motives favour this study. Having both a Software Engineering background and studying Management of Technology provides a huge benefit. Being up to date with all the new technologies available for people, while also understanding the way how to introduce new, highly digitalized solutions to the world is a unique combination. Seeing the problem, which has occurred not only to the author but also to many closely related people shows that maybe new technological advances might be very suitable to solve it or at least improve it once and for all.

This research is relevant not only to academics but also to practitioners and policymakers involved in public participation processes. The findings of this research can inform the development of new strategies and tools for increasing citizens' engagement in public participation. Municipalities will have one more reason to invest in new technologies to further unite and include everyone in the community. Furthermore, the implementation of blockchain and NFTs in public participation processes can have significant societal implications by promoting transparency, accountability, and citizen empowerment. Therefore, it is important to understand the potential of these technologies and how they can be effectively used to enhance public participation.

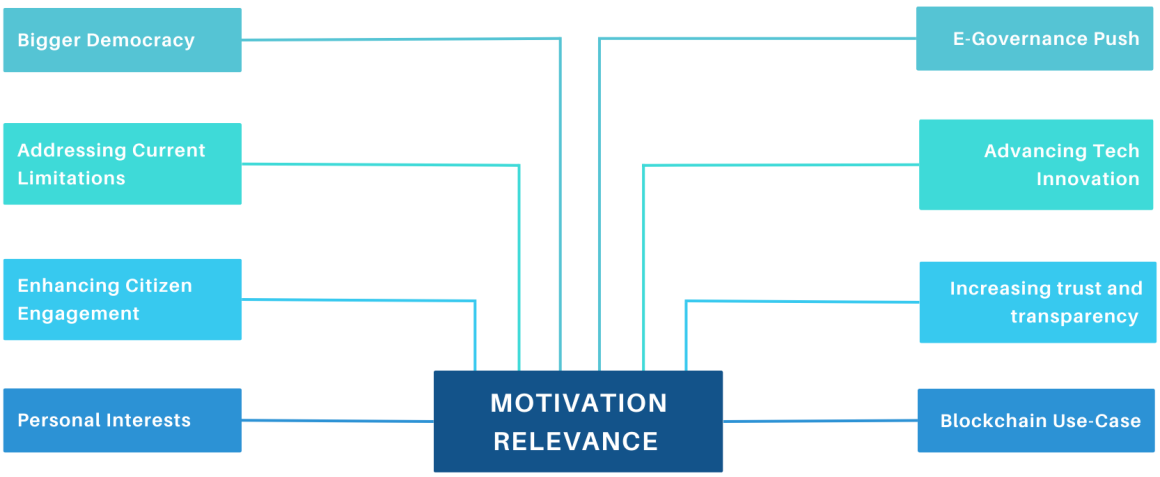

Figure 1.3: Motivation & Relevance

1.3. Research Formulation

Overall, this research aims to provide a comprehensive understanding of the impact of an innovative blockchain and NFT approach on public participation in the local government decision-making process and to provide insights that can inform the implementation of similar solutions in other cities.

1.3.1. Research Objective

1. To understand the current state of public participation in the local government decision-making process

2. To analyze the effectiveness of blockchain and NFT technology in tackling the challenges of current public participation methods
3. To identify any potential challenges and limitations of implementing a blockchain and NFT-based platform for public participation

1.3.2. Research Question

The main research question is formulated as follows:

RQ1: What is the added value of an innovative blockchain and NFT approach on public participation in the local government decision-making process?

The question is trying to understand if the implementation of a blockchain and NFT-based platform can encourage citizens to be more involved in creating awareness about problems within the community and encouraging active participation in the decision-making process, and if so, to what degree. The evaluation of the effectiveness of the proposed solution in terms of increasing public participation, engagement, and awareness of community issues is performed. Overall, with the main research question the paper tries to understand if an innovative blockchain and NFT approach can be an effective solution for increasing public participation in the local government decision-making process and provide more insights into how to implement a similar solution in the cities.

SRQ1: What is the current state of public participation in the local government decision-making process?

This sub-question aims to understand the current levels of public engagement and participation in the decision-making process in local government. It includes data on the number of citizens who participate in public meetings or submit feedback on community issues. Literature review and analysis of the statistics as well as interviews with government officials will provide enough data to answer the question.

SRQ2: What are the potential challenges and limitations of the current public participation methods?

This sub-question aims to identify any potential challenges and limitations of the public participation methods that are currently used. It includes information on the different ways how to engage people in public participation. Both the literature review and the interviews with government officials are performed to analyse thoroughly this question.

SRQ3: To what extent can blockchain and NFT technologies tackle the challenges and limitations existing in the current public participation methods?

This sub-question aims to identify the impact of blockchain and NFT solutions on tackling the issues found in *SRQ2*. A literature review, as well as interviews with blockchain experts, will help identify the potential rewards.

SRQ4: What would be the implementation challenges of using the blockchain and NFT approach in public participation in cities?

This sub-question aims to identify any potential challenges and limitations that cities may face when implementing a blockchain and NFT-based platform for public participation. It includes data on technical challenges, such as issues with scalability or security, as well as challenges related to user adoption and engagement. An extensive literature review is performed to answer this question, including interviews with government officials and blockchain experts. It also aims to provide recommendations and a framework on how cities can overcome the challenges and limitations identified in *SRQ3*. The designed framework in one of the chapters will provide a detailed description for tackling the challenges as well as involving all of the necessary stakeholders in the process of designing the solution.

1.3.3. Research Approach

The research method that can be used to achieve these objectives can be mixed-methods research. It will include a combination of quantitative and qualitative methods such as surveys and interviews. Surveys will be used to gather data on the current state of public participation and to measure the potential impact of the proposed solution on citizen engagement and awareness. Interviews will be conducted with local government officials, community leaders and blockchain experts to gain deeper insights into the effectiveness of the proposed solution and any potential challenges and limitations.

1.3.4. Research Scope

Due to the different regulations across the countries and cities, it is almost impossible to evaluate the generic concept for the entire European Union. This research will focus mainly on Delft city and municipality, to perform the surveys with the citizen to understand their current stance and point of view. The main reason for choosing Delft is due to the proximity to the current residence of the researcher and known issues within the public participation in the region. What is more, to further understand the regulations standing for or against the introduction of such emerging technologies, mostly the government officials from the same region will be interviewed. As for the blockchain experts, such a requirement is not necessary. Many of the experts in the area live in multiple places in the world and their relation to the specific city is not required.

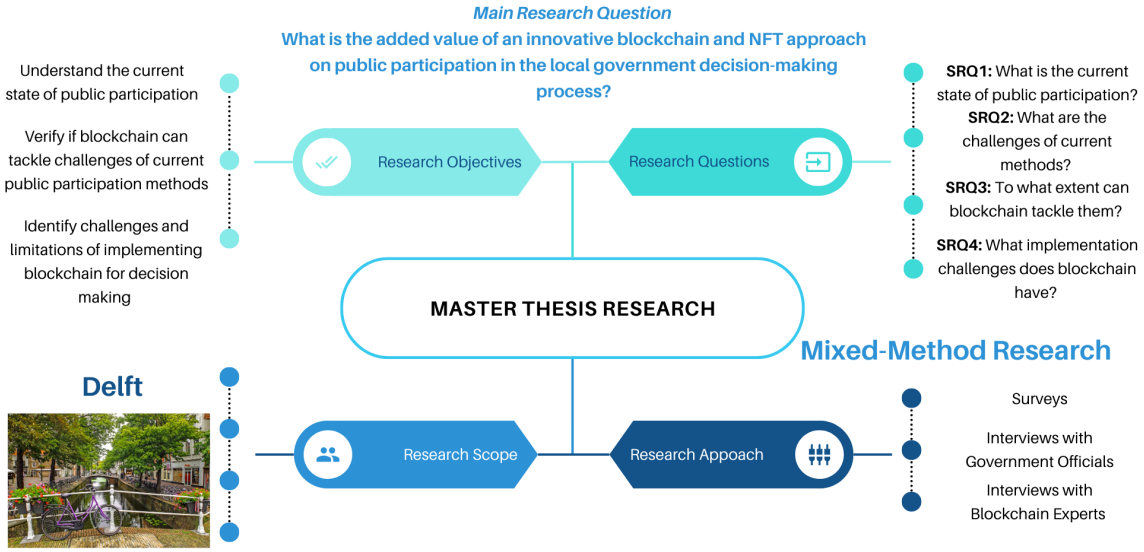

Figure 1.4: Research Formulation

1.4. Structure of the Report

The first **Introduction** chapter provides an overview of the problem being addressed with necessary background information, including the current state of public participation in local government decision-making and their limitations and challenges and the need for an innovative solution. The **Methodology** part describes how the research has been conducted to gather data and information for the report like surveys and interviews. What is more, information about the data analysis techniques and the keywords are put there to allow for easy repeatability of the study. The **Literature review** is a review of the existing literature on the topic of public participation in local government decision-making and e-governance, including the potential of blockchain and NFT technology to address the issues of current public participation and any practices that are already used for implementing blockchain solutions in the cities. The **Data Collection** chapter presents the findings of the research, including data and information gathered through the research methods. The **Analysis & Results** chapter provides both an analysis of the results, as well as a detailed description of the main findings that were understood through the research, such as the most viable group to influence and as well as answering the question of whether usage of such technology is viable in the context of public participation. It also discusses key insights and observations that emerged from the research. The **Conclusion** part summarizes the main findings and conclusions of the research and provides the necessary perspective for both policymakers as well as blockchain and e-governance researchers for the future. In the concluding chapter, the answers respectively to every sub-research question and to the main research question are presented in a concise form. It also provides the most important information about future research that would be necessary to perform to obtain more understanding of the topic of blockchain in public participation.

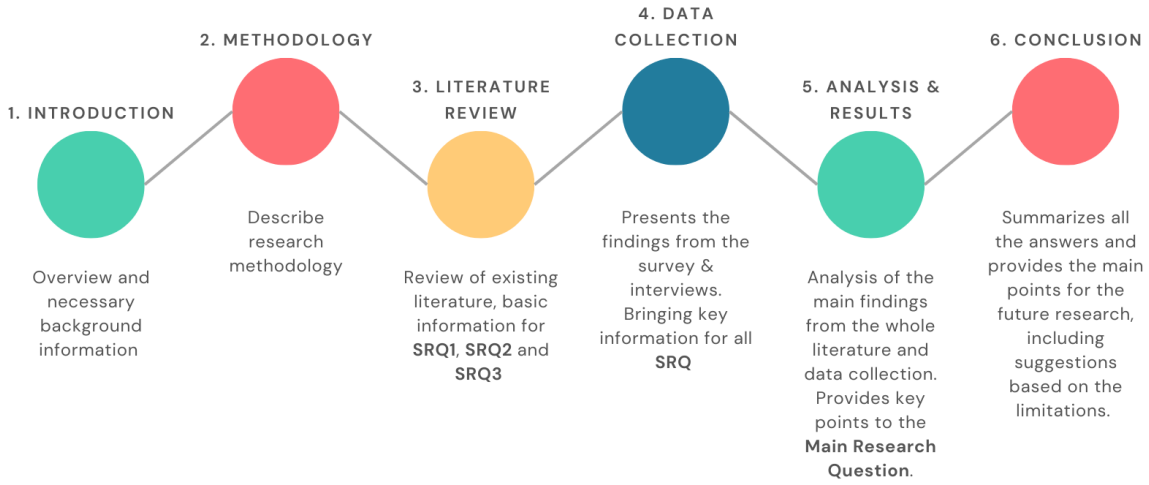

Figure 1.5: Master thesis chapters

2

Methodology

This chapter explains the research methodology and how the research has been performed. It includes information about the literature review, as well as interviews and surveys that have been conducted throughout the work. As mentioned in the introduction part, the research method to achieve the before-mentioned objectives would be mixed-method research. Starting with the surveys throughout the people to understand and see the current state of public participation and gather more realistic data about the needs of the citizens. Apart from that, there has been performed more qualitative approach with the interviews, to gather more advanced data from specialists - both blockchain experts as well as policymakers. Last but not least, the research in the recent publications, as well as the knowledge of the author has been highly utilized to combine all available resources.

2.1. Research Design

In this research, method triangulation is going to be used, so both qualitative as well as quantitative research has been performed. As mentioned above, the data for the research will be collected from the following sources: literature, surveys and interviews. The literature is gathered from publicly known databases such as Google Scholar. In order to gather only relevant data, only the recent documents, as well as documents related only to specific keywords are taken into account. The survey is provided to several multiple citizens living in Delft, who can share their experiences and needs in order to further improve public participation in the city. The interviews are going to be performed with the selected specialists and individuals who have experience in local government politics or the blockchain industry. All of the data collection methods are performed in non-contrived settings, without any changes to the natural environment. The main unit of analysis is the individual - as it is important to understand the pain points of current public participation methods and find out whether highly modern ways could bring more benefits than those. The data collection is performed during the one-time horizon, as a one-shot study.

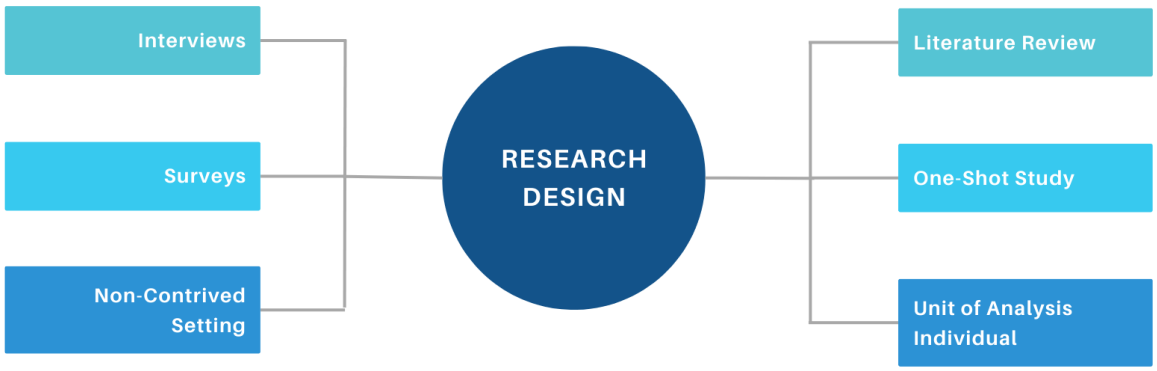

Figure 2.1: Research Design

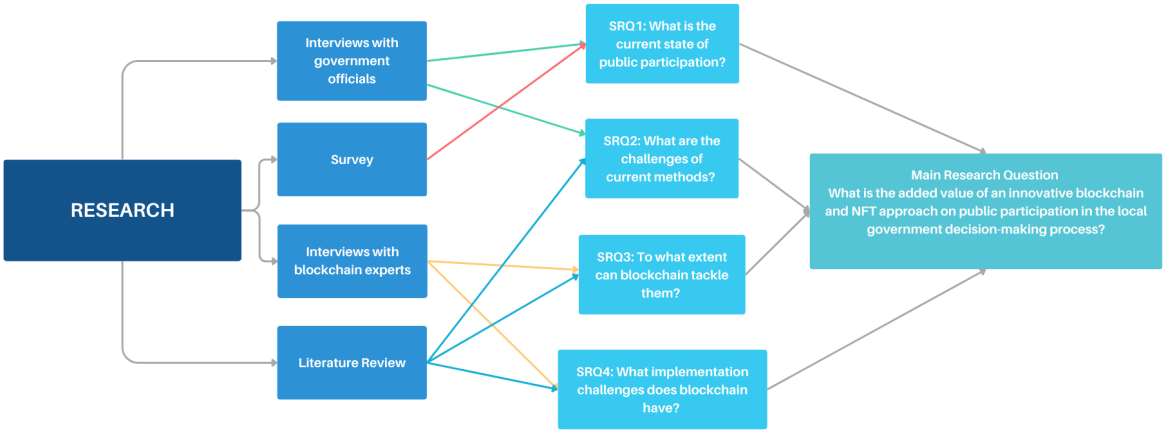

Figure 2.2: Methodology to research question diagram

2.2. Literature Review

The main literature sources had been collected mostly from google scholar with several exceptions. There were explored both topics from the blockchain and NFT perspectives as well as from the current status and ways to increase public participation in the decision-making process. The example keywords and their synonyms are presented below:

Keyword	Synonyms
public participation	citizen participation, citizen engagement, public engagement
local government decision-making	municipality decision-making, decision-making in cities
public meeting attendance	citizens attendance, advisory committees attendance
blockchain in local government	smart cities and blockchain, decentralized governance
NFTs and community engagement	blockchain and citizen participation
e-Government	digital government, e-governance
eParticipation	digital participation, online participation

Table 2.1: Keyword search table

The search started with the provided keywords and was sorted by the relevance of the results on the Google Scholar database. Based on the provided results, the first screening of the relevance of the paper to the research - and verification, of whether it is something that might be useful for the work. The author's intuition as to the usefulness of the paper was firstly based on the title, then on the year. Due to the three domains being analysed here: blockchain and NFTs, public participation, and e-Government, rules for accepting and declining the paper have been different for them. For the first one, papers from before 2017 have been completely declined, due to the technology being relatively new. The whole implementation details and the possibility of implementing it in cities is an extremely modern topic, which is currently under investigation. Regarding public participation, as this is a thoroughly analysed topic, there were no such restrictions, except for the more tendencies to use the newer version. Last Apart from looking at the data, the potential usefulness of the article and relevance, look at the abstract and speedy reading of the research paper have been performed. After reading the abstract and skimming the work, further decisions have been made about the given article. Some of the articles had a very interesting reference for instance about the current state of the blockchain, NFTs or public participation. Those references have been also added to the list of sources. Last but not least, the e-Government articles have been analysed from the main of their fields as well as the ones that seemed the most related to the research. Also, the articles found from the EU government with important points and advice towards the eGovernment have been

thoroughly skimmed to understand and provide a better view on this topic. Below, are the main reasons that some of the articles have been dropped:

1. Article was published in a different language than English
2. The article topic was not related to the research and work
3. The article was published too many years ago
4. The article abstract did not present the relevance to the presented topics
5. The article abstract was not related to the research and work
6. ”Skimming” of the article did not provide useful results

2.3. Surveys

Surveys are mostly used to gather data on the current state of public participation and to understand the requirements and main pain points of citizens within the current public participation processes. Apart from that, more information about the features that would increase citizen engagement is gathered, to evaluate the potential of blockchain products as a viable solution to this growing problem. They will be performed against people living in Delft. The questionnaires are going to be mostly distributed electronically through online available platforms. The main purpose of the questions is to understand people’s current involvement in public participation. It is important to understand the main pain points of people (if any) to understand whether the potential solution might help them or not. The surveys will consist of appropriately chosen wording (without any positively or negatively worded questions) with mostly closed questions. The anonymity of the people participating in the research is going to be fully utilized, no names will be collected and all the data gathered are going to be utilized only for this research. All the data gathered will be validated and thematically analyzed (especially in the context of a few open questions). As mentioned previously, the data will be anonymized to ensure the security and confidentiality of the respondents.

2.3.1. Sample Size

First of all, in understanding the appropriate sample size, the concept of statistical significance has to be introduced. Statistical significance is used to determine whether the result is a matter of an accident or a valuable inside towards the research (Investopedia, 2021). In order to obtain the statistical significance in the number of responses in the survey, some calculation has been performed. According to the latest data, there are approximately 106k people living in Delft in 2023 (CityPopulation, 2023). In order to obtain the statistical significance, several additional constants have to be agreed upon, such as confidence level and margin of error (Sekaran & Bougie, 2016). The confidence level is a way to understand how sure we are that the results of the survey are really accurate (Statista, 2019). The margin of error is a percentage which helps understand how much from the real value are gathered results off (Hunter, 2016). Both of those values are chosen subjectively, after taking into account available resources and time limitations in the data collection process. Understanding those limits, the confidence level is set to be 90% and the margin error is set to 10%. Based on those values, the minimal amount of surveyed people is approximately 67, however, the research aims to gather as many responses as possible to improve those values.

2.3.2. Respondent Profile

The survey conducted in the research is designed to gather feedback and insights from citizens who are affected by the decisions made within the city. The respondent profile for these surveys includes individuals who are either current residents of Delft or have previously lived in the city, which additionally have the voting power (older than 18)(Delft, 2022c). An additional criterion is including the people who are affected by the city decisions made within its boundaries, such as people who spend most of their time in Delft (studying or working) and are directly/indirectly affected by any changes. This specific criterion ensures that the opinions and perspectives captured in the surveys come from individuals who have a direct connection to the city and its affairs. By targeting citizens who are actively impacted by the decisions made in Delft, the surveys aim to gather valuable insights that reflect the diverse interests and experiences of those who have a vested interest in the city’s development and future.

Age: 18+, can vote
Geographic Location: Delft and its proximities
Previous experience: Openness for changes
Affected by decisions: Directly/Indirectly
Gender: Any
Occupation/Employment: Any
Educational Background: Any

Figure 2.3: Main Characteristic of Survey Respondent Profile

2.4. Interviews

Interviews will be conducted with local government officials, community leaders and blockchain experts to gain deeper insights into the effectiveness of the proposed solution and any potential challenges and limitations. Mostly the meetings will be structured with topics appropriate to the knowledge of the interviewee - blockchain experts about potential advantages of introducing it to the cities with their requirements, while from the government officials, more limitations and regulations which are necessary to follow that might hinder such a possibility. Until the questions will be asked they will be reviewed and verified so that all of them are unbiased and clarified. In the current world, the interviews probably mostly will be performed through online communicators such as Google Meet, Microsoft Teams or Zoom, however mostly it will be established when trying to contact the appropriate experts, as some of them might prefer to be talked face-to-face. As for the government officials, they will be from Delft as well as the community leaders. Blockchain experts, due to the remote possibility of working do not have the necessity of being in Delft however they must be competent and have experience working in that industry - such as the creation of their own cryptocurrencies.

2.4.1. Blockchain Expert Profile

In order to gain in-depth insights and expertise on the subject matter, this research used a targeted approach by conducting interviews with individuals who possess extensive knowledge and experience in the field of blockchain technology and NFTs. The interviewees consisted of blockchain experts who have obtained extensive knowledge in the blockchain industry, including those who have created their own cryptocurrencies or NFTs. Moreover, the participants were selected from various backgrounds, such as research laboratories and companies specializing in cryptocurrency development and applications. By engaging with individuals who possess firsthand experience and a deep understanding of blockchain and NFT technology, this research aimed to gather valuable insights and perspectives from experts actively involved in the cryptocurrency world. Their expertise and insights provided valuable contributions to the analysis and discussion of the potential applications and implications of blockchain and NFT technology in public participation and governance.

Field: Blockchain/E-Governance/NFT
Years of Experience: 2+
Work: Research laboratory/Company
Achievements: Created NFT/Cryptocurrency
Gender: Any
Geographic Location: Any
Educational Background: Any

Figure 2.4: Main Characteristics of Blockchain Respondent Profile

2.4.2. Government Official Profile

To ensure a comprehensive understanding of the public participation landscape and gather insights from the government's perspective, this research incorporated interviews with government officials who play a vital role in public participation processes. The interviewees were selected from various government departments, including those involved in organizing town hall meetings, engaging with citizens, enforcing

laws within the city, and making important decisions that impact public participation. These government officials represented different political parties, allowing for a diverse range of viewpoints and perspectives. By engaging with individuals actively involved in public participation and governance, this research aimed to gain insights into the current practices, challenges, and opportunities associated with citizen engagement. Their experiences and perspectives provided valuable insights for understanding the dynamics between the government and citizens and identifying areas for improvement in public participation processes.

Position: Government Official/Politician
Geographic Location: Delft
Previous experience: Decision-Making Process
Activities: Direct contact with citizens
Gender: Any
Educational Background: Any

Figure 2.5: Main Characteristics of Government Official Respondent Profile

2.5. Data analysis techniques

To interpret and analyse the data appropriate data analysis techniques are necessary. In the case of surveys and mostly quantitative data the questions would be mostly on the Likert scale, so the ordinal scale. On the one hand, for surveys multiple visual summaries are going to be used to present the results. Data visualisation, as well as thematic analysis, can be used to thoroughly analyse the data. The answers gathered from the citizens, as well as the statistics can be used to answer the *SRQ1*. On the other hand, from the perspective of the interview, the data will be analysed differently. First of all, due to the probably huge amounts of data, it will be reduced using the coding method. Afterwards, the categorization process will be started to appropriately organize the results. With the appropriate categories and codes created (mostly from the interviews, however, some of them might result in open-ended questions from surveys) the data can be further displayed on the appropriate diagrams with thematic or content analysis to understand and answer mainly the questions *SRQ2*, *SRQ3* and *SRQ4*. After a comprehensive analysis of both results from the surveys and interviews, with a literature review, there would be enough evidence to support the results and answers for those sub-research questions.

To properly analyze the data, it is necessary to combine the results from interviews with government officials and blockchain experts and the surveys. First of all, the similarities and differences in the perspectives of the participants (both interview and survey) will be analyzed. Such an approach can provide more insights into the current state of public participation and provide any additional room for potential improvement. Secondly, the surveys will help in identifying the specific areas where Delft citizens would like to be more involved in the decision-making process in the city. It can be a useful insight into understanding what kind of limitations currently used methods have, while also can provide valuable information on the changes that are necessary to perform. Comparing the perspectives of the interviews with blockchain experts and government officials can help in identifying the barriers to public participation and the potential role of new technologies in overcoming those barriers. It can also be used to develop a list of recommendations for all the stakeholders and policymakers to further enhance public participation. As soon as the data is gathered and analysed, further evaluation towards the research questions is presented to answer the main topics that this research focuses on. All of the potential improvements can bring many positives within the city governance, helping both the citizens as well as the government.

3

Literature Review

This chapter of this thesis focuses on exploring the current state of knowledge on the potential usage of blockchain technologies to increase citizens' involvement in public participation. With the emergence of blockchain technologies, there has been an increasing interest in exploring its application in various fields, including public participation. The decentralization and transparency features of blockchain technology provide a potential solution to many of the challenges faced in public participation. This chapter aims to review the relevant literature and identify the existing knowledge gaps, potential benefits, challenges, and limitations of the currently used public participation methods, as well as inform more about blockchain technology in public participation. The findings of this chapter will inform the subsequent discussion on the potential implementation of blockchain technology to increase citizens' involvement in public participation.

3.1. Public participation

Public participation is a concept that has been extensively studied in the literature and refers to the involvement of citizens in the decision-making processes of governments and other institutions (Quick & Bryson, 2022). The importance of public participation lies in its ability to give citizens a voice in matters that affect them, provide feedback to decision-makers, and increase the legitimacy and transparency of decision-making processes. While there are many benefits to public participation, there are also challenges and limitations that need to be addressed to ensure its effectiveness. Currently provided methods and *state of the art* solutions to enhance public participation do not provide a comprehensive way to tackle the problem, and each of them has some flaws.

3.1.1. State of the art

In recent years, many countries have implemented public participation methods in an attempt to increase citizen engagement and involvement in government decision-making. Covid-19 has also made some changes introducing a more digitalised approach. Nowadays, there are several multiple ways to engage citizens in public participation. Some of the solutions are more suitable for young people, while others target the older part of society. The most common methods used today are community meetings, advisory committees, crowdsourcing, deliberative democracies, incentivizing government and online platforms (Rowe & Frewer, 2000). The more comprehensive and extensive list is presented below.

1. **Community meetings**, town halls, and public hearings, where citizens can meet with government officials and other stakeholders face-to-face to discuss important issues and provide feedback (Einstein, Palmer, & Glick, 2019).
2. **Advisory committees**, task forces, and working groups are composed of representatives from the community, government, and other relevant organizations and are charged with providing input and recommendations on specific issues or projects (Dutta & Fischer, 2021). Many of those committees have been established during the Covid crisis to further enhance and improve the lifestyle and prevent the spreading of diseases during the pandemic.
3. **Crowdsourcing** and citizen science initiatives, which leverage the collective knowledge and expertise of citizens to inform decision-making (Shanley, Parker, Schade, & Bonn, 2019).
4. **Deliberative democracy** practices, such as citizen juries, consensus conferences, and deliberative polls, are designed to promote informed and inclusive public engagement in decision-making (Willis,

Curato, & Smith, 2022).

5. **Incentivizing government** officials to take citizens' feedback into account by making them accountable or by making the process of decision-making transparent (Matheus, Janssen, & Maheshwari, 2020).
6. **Online platforms** and tools for public engagement, such as web portals, social media, and mobile apps, allow citizens to share their opinions, ask questions, and track the progress of decision-making processes (Labosier, 2020). An example of such a platform is Metroquest.

Figure 3.1: Public Participation Methods

3.1.2. Delft Approach

Delft's approach to public participation is focused on inviting a diverse group of citizens to participate in workshops, meetings, and events to provide their input on a particular issue or decision. These workshops and events are designed to encourage constructive dialogue and exchange of ideas between citizens and government officials. Delft also involves using a variety of communication channels, including social media and the internet, to inform and engage citizens in the process. The aim of this approach is to ensure that the public's input is taken into account in the decision-making process, ultimately leading to more informed and legitimate decisions.

Starting with the Delft Internet Panel platform (Delft, 2022b), this is an important step towards digitalization. It consists of a group of citizens who have voluntarily registered to participate in the platform and provide their opinions. The government presents cases related to policies, plans, or projects, and the panellists are invited to provide their opinions and suggestions. The platform provides an opportunity for citizens to express their opinions and contribute to decision-making processes without the need to attend physical meetings.

Delft Doing is another initiative under the Delft approach to public participation (Delft, 2022a). It involves a careful process of cooperation between the municipality and citizens to come up with new ideas and solutions for urban challenges. This process begins with turning yourself to the city and visualizing the potential for changes. Next, it is important to talk to multiple stakeholders, arrange the agreements as well as perform the multi-actor decision-making process sharing all the problems, ideas and possible bottlenecks. Last but not least, it is important to work out the initiative and make the appropriate report, when everything is appropriately arranged the ideas can be submitted to the city.

In addition to its traditional methods of public participation, such as the Delft Internet Panel and Delft Doing, the city of Delft has also been increasingly engaging digital communities to involve them in decision-

making processes. The city, apart from the typical town hall meetings and newspapers, started using new mediums such as Instagram to reach another target group and inform a bigger part of society about their decisions. Such decisions are a great start towards the new society, getting more and more digitalization into governance.

Summing up the Delft approach in public participation, they have started utilising new technologies and trying to engage digitally with the citizens. On the one hand, they try to have a group of individuals voluntarily participate in the decision-making platform and gather much more people, than by using only the physical approaches. On the other hand, there is still a lack of statistics available about any number of creating citizen initiatives as well as the increase or decrease in the number of citizens participating in the decision-making processes presented by the cities. Previously mentioned methods also have their own limitations and challenges, that municipalities have to face while implementing them.

3.1.3. Challenges and Limitations

The current state-of-the-art public participation methods have been found to face several challenges and limitations (Mostert, 2003). Firstly, the traditional approach has limited reach of citizens, as some groups are more difficult to engage than others, resulting in a skewed representation of the population. One of the major challenges is the lack of two-way communication and feedback between the government and citizens. Additionally, public participation methods are often time-consuming and logistically challenging, making it difficult to achieve broad participation. What is more, setting up multiple meetings, designing the committees and gathering multiple experts can also be incredibly resource-intensive and extensive - both from the money side as well as timewise. There is also a lack of transparency in the decision-making process, which can lead to mistrust and scepticism from citizens. Finally, for poor people access to technology if it's necessary can become a problem, especially in the new digitalized world.

1. Community meetings and public hearings can be time-consuming and logistically challenging to organize, and may not reach a representative sample of the community. Additionally, these events can be dominated by a small number of vocal participants, making it difficult for quieter or more marginalized voices to be heard (Baker, Addams, & Davis, 2005).
2. Advisory committees, task forces, and working groups can be costly to establish and maintain and can be perceived as exclusive if not properly designed and implemented. Additionally, the effectiveness of these groups is highly dependent on the quality of their membership and their ability to engage with the community (Vari, 1995).
3. Crowdsourcing and citizen science initiatives can be complex to design and implement, and may not be well-suited to all issues or populations. Additionally, they can be subject to bias and misinformation if not properly moderated (Louv & Fitzpatrick, 2012).
4. Deliberative democracy practices can be costly and resource-intensive, and may not be feasible or appropriate for all issues or communities. They can be also perceived as exclusive if not properly designed and implemented (Committee, 2022).
5. Incentivizing government officials depends on the political culture and the willingness of the officials to be accountable and transparent. Additionally, a lack of oversight and monitoring mechanisms can make it difficult to ensure that officials are following through on citizen input. Some cities, such as Rio De Janeiro have already tried to make the decision process more transparent through the usage of dashboards (Matheus et al., 2020). However, without appropriate cleaning of the data, it might result in wrong analysis and therefore wrong decision.
6. Transparency of the process in many ways is not obvious. Many of the citizens still do not know or understand the reasons for decisions made in the city and might feel that they are being done without consultation with experts (Rowe & Frewer, 2000).
7. Access to technology and the internet can be a barrier for some citizens, particularly those from low-income or marginalized communities. Additionally, online engagement can be less effective for certain issues or populations, such as older adults or those with limited literacy skills. What is more, simple social media platforms, do not incentivise people to further share their problems with the officials. Many of the problems might be forgotten, due to the lack of incentive for the citizens for sharing them (Van Dijk, 2017).

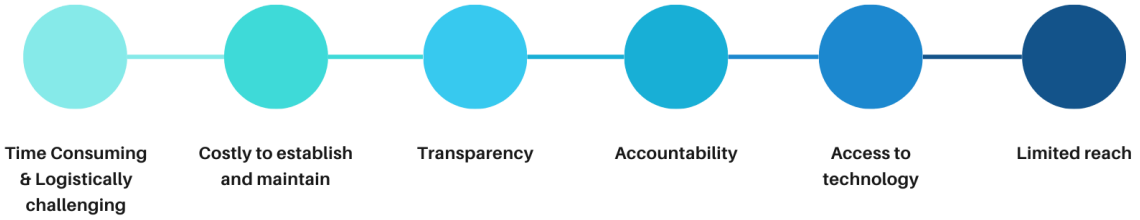

Figure 3.2: Challenges and limitations of currently used methods

Given the challenges and limitations of traditional public participation methods, there is a growing interest in exploring how emerging technologies can address these issues, especially after the Covid-19 pandemic, multiple cities and countries started investigating digitalization and online solutions as a potential solutions to multiple problems (Pantić et al., 2021). One promising technology that has gained traction in recent years is blockchain. The use of blockchain in public participation has the potential to provide a more secure, transparent, and inclusive platform for citizens to engage in decision-making processes. In addition to blockchain, non-fungible tokens (NFTs) have also emerged as a potential tool to incentivize citizen participation and increase engagement in public participation.

3.2. E-Government

The rapid advancement of technology in recent years has led to significant transformations in various sectors, including governance and public administration. E-government, as a response to the growing demand for efficient and citizen-centric governance practices, has emerged as a critical area of research and implementation. E-Government encompasses the use of information and communication technologies (ICTs) to enhance government operations, service delivery, and citizen participation (Heeks, 2001).

Figure 3.3: What is E-Governance (Belize, 2021)?

There are multiple articles which mention the usage of e-government towards public participation. One of the articles mentions directly the possibilities of the technology towards improving public participation (Davies, 2015). In this article, the main terms and ideas are presented not only towards the eGovernment but also to a more specific term called eParticipation. As recognized, eParticipation consists of multiple

tools, not only social media but also platforms, blogs and forums. In this article, several main points have been recognized, such as the need for two-way communication and the possible increase in the digital divide. Apart from that, not all governments wish to inform the citizens about those possibilities and some of them even discourage citizens to do so, opposing democracy. Last, but not least, there is an incentive towards including a multi-language society and making sure that everything is understandable for the citizens in the country, even those that do not speak the main language. Yet, it is still not available on a global scale. The article recognizes several technologies for future research, such as mobile and cloud computing. However computing power would not affect the increase in public participation at all, but this is only a cost-efficiency solution. There is a lack of research towards other emerging technologies, like blockchain and NFT or AI.

Several articles also focused on the effects of the transformation towards the more digital world. One of them tries to verify the citizen attitudes and understand, whether all the assumptions for e-Government are fulfilled when implemented (West, 2004). The article analyzes and assumes that there is a small influence of the e-Government on the trust between the citizens and the politicians. What is more, it correctly understands that the e-Government is a slow, incremental process, as multiple municipalities and countries spend very small amounts of money on the implementation of new technologies, especially towards public participation, where the result cannot be easily quantified. Nevertheless, it is worth noting, that this article has been created in the 2004 year. Even though it provides multiple useful insights, in the last 20 years, there have been 2 major changes that would influence the current result. First of all, the technological advances have been enormous, creating faster networks, new social media platforms and more intuitive designs. All of which would affect the number of people actively participating in the decision-making process. Secondly, a new generation of people got their voting rights. Their life and cultural approach is much different than from the people many years ago, which might highly affect the potential main points that have been discovered. Similar research with the newest data and people across all age groups should significantly help to understand the main points of the transformation.

Other articles focus also on the transformation from the old way of public participation towards the digital one (Torres, Pina, & Royo, 2005). As shown in the article, the transformation several years ago was very slow, moving mostly not only to public participation but only to the service delivery pattern. What is more, during that time public participation was not one of the emerging topics in the e-Government industry. On the one hand, the article mentions that the new technologies and so-called e-Government have the possibility of positively affecting the relationship between the government and citizens. On the other hand, this relationship and also an increase in trust and other effects will be very hard to measure, requiring significant research towards that area. The main topics, which are provided by the article such as transparency, openness, accountability and mechanisms for participation (Torres et al., 2005) are one of the main points of one of the newest recent technologies called blockchain.

3.2.1. E-Governance strategies

Several different strategies for e-governance has been discovered, such as Government to Government (G2G), Government to Citizen (G2C) and Government to Business (G2B) (Intactone, 2020). It is important to mention that the usage of technologies in any of these strategies should depend on the specific use cases of every of them. In every one of these scenarios, different approaches might require different features. Government to Government might focus more on the security and availability of the solution (Fan, Zhang, & Yen, 2014). What is more, they showed the study to be more analyzed towards the organizational readiness and possibility of the adaptation by multiple stakeholders, which is also important on the start. Different requirements also have Government to Business approach. Information quality and operational effectiveness might be the major factors that would affect the cooperation between those stakeholders (Santa, MacDonald, & Ferrer, 2019).

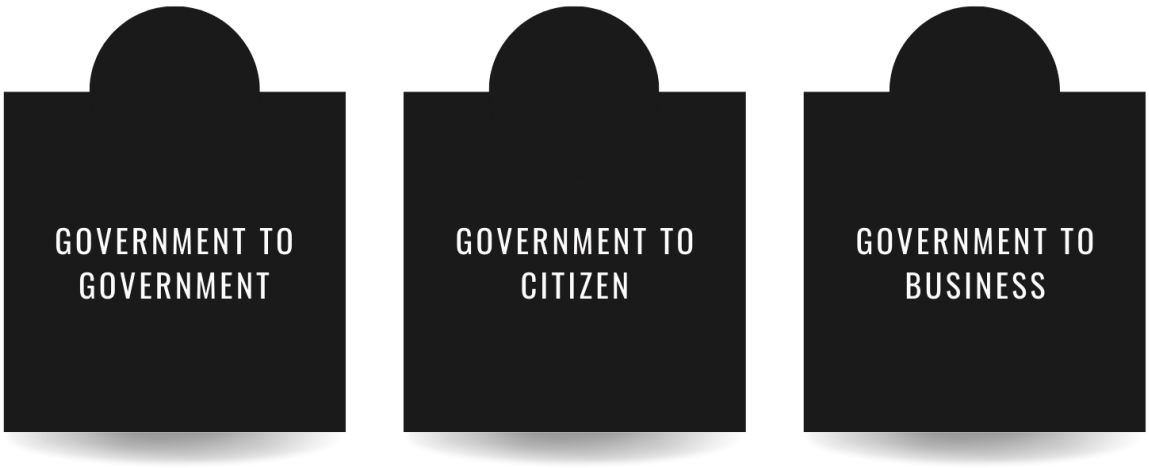

Figure 3.4: Main E-Governance strategies

However, Government to Citizens strategy has also different needs. Starting with several main features like ease of use and usability (Hussein, Mohamed, Rahman Ahlan, & Mahmud, 2011). As soon as the citizens will be able not only to quickly use the system but also the system will be sufficient for all their use cases, without the need for offline participation - it will bring a huge increase in the value and engagement of the citizen.

Other articles also provide studies on the usage of new technologies and several main factors that have been discovered as necessary to satisfy the citizens. Several different adoption models and frameworks have been analysed to ease the way of introducing the given solution to citizens (Marzooqi, Nuaimi, & Qirim, 2017). Multiple important success factors have been identified as crucial in the introduction of e-governance and new technologies, such as environmental, behavioural, organizational and technological. This article provides a great understanding of the factors that influence potential adoption not only from the perspective of the municipality but also the needs of the citizen, giving a nice overview of what the future solution should focus on. Several main features can be specifically stated here as transparency, privacy, communication, political stability, trust and accessibility (Marzooqi et al., 2017). In case any technology will be utilized to tackle the challenge of introducing e-governance, it should really focus on providing a reasonable approach towards these features.

3.3. Blockchain, NFT and DAO

One of the newest technologies that have started disrupting the current approach is blockchain. Blockchain technology is a decentralized digital ledger that allows for secure and transparent data management without the need for intermediaries. Initially, blockchain technology was associated solely with cryptocurrencies, but it has gradually expanded into a range of other fields, including supply chain management, voting systems, and public administration (Zheng, Xie, Dai, Chen, & Wang, 2018). The blockchain's decentralized nature ensures that no single party has control over the information stored in the network, providing a transparent, secure, and efficient means of conducting transactions. Given its potential to enhance transparency and security, blockchain technology is becoming increasingly popular in the public sector.

Non-fungible tokens (NFTs) have emerged as a new application of blockchain technology in recent years. NFTs are unique digital assets that are stored on a blockchain, providing a secure and immutable record of ownership and transfer (Wang et al., 2021). They have been primarily used in the art world to create a new market for digital art, but their potential applications extend far beyond the art industry. NFTs have been proposed as a way to create verifiable digital identities, enable secure voting systems, and facilitate the transfer of ownership of a wide range of digital assets, such as music, videos, and game items. In the context of public participation, NFTs could be used as a means of incentivizing citizens to participate and contribute to public decision-making processes. By creating unique, valuable digital assets that are

tied to participation in public initiatives, NFTs could help to increase engagement and promote a sense of ownership and investment in the decision-making process.

Decentralized Autonomous Organizations (DAOs) are an emerging type of organization that operates on the blockchain network. In simple terms, a DAO is a digital organization that is run by smart contracts and governed by its members, who make decisions through a decentralized voting process (Diallo et al., 2018). This decentralized structure allows for a more democratic and transparent decision-making process, where each member has an equal say in the organization's direction. DAOs can be used in various applications, including crowdfunding, decentralized finance, and digital identity management. With the increasing interest in blockchain technology, DAOs are gaining more attention as a promising way to disrupt traditional centralized organizational structures, including public participation (Diallo et al., 2018).

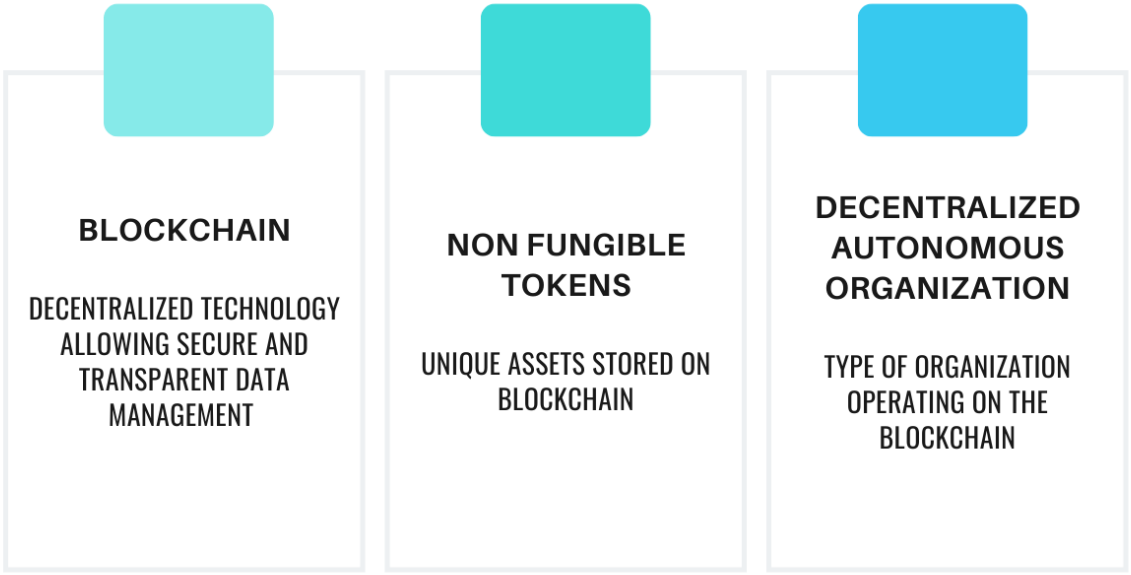

Figure 3.5: Blockchain, NFT & DAO

Blockchain technology, non-fungible tokens (NFTs) and decentralized autonomous organizations (DAOs) are currently hot topics in the technology industry. There are constantly new projects created in the cryptocurrency world. On the websites such as OpenSea or Binance, new listings show up even every second and people participate in the auctions all the time to get the NFTs as soon as possible. Constantly new startups and ideas are being introduced, including coins and DAOs where people together believe in a huge profit from their concept. What is more, the number of crypto-related startups is growing exponentially in recent years. There have already been created companies which try to use the technology in almost every industry, starting from health, through retail as well as real estate.

Several researchers have already analysed the NFTs from the perspective of potential usage by the creative industry entrepreneurs - both musicians and artists while also the ventures such as art galleries and recording labels (Chalmers, Fisch, Matthews, Quinn, & Recker, 2022). Comprehensively, they presented potential opportunities and threats for both short-term and long-term situations. Even though the paper presents multiple generic situations, it focuses only on this specific creative industry - where the potential for unique and creative work is infinite. This article sufficiently justifies the potential of NFT, especially in creating ongoing revenue streams, however, further research for other industries is necessary. On the one hand, some of the articles also analysed multiple artworks available on the blockchain and tries to quantify the information about them. There is a comprehensive analysis done, including an analysis of the network of artists and collectors as well as social media. On the other hand, there is a lack of analysis of the whole collections - for instance, the Cryptopunks (LarvaLabs, n.d.) as well as an understanding of why

the specific collections were successful - not only based on the potential information about the number of people following the collection but also retweets, amount of information in the internet, as well as the additional benefits that it provided: such as access to the close community group with other celebrities (Vasan, Janosov, & Barabási, 2022).

3.3.1. Perspectives and Opportunities

Apart from those examples, there have already established several trends for the future of NFT technology. Such examples are personal health monetization as well as healthcare (Kuchminskaya, 2022). Nevertheless, this article does not provide any information about the potential implementation of it to the existing company. Similarly, as the first analysed paper, this one also focuses on the creative industries. It points out the main very important feature of the NFTs in this business - it brings the creators much closer to the buyers, therefore making huge intermediaries unnecessary and obsolete. The paper provides a good explanation of everyone's perspective after the implementation of the NFTs - the buyer, the creator as well as the market and creates several research opportunities related to the creative industry - mainly related to measuring market performance, design and strategic behaviour. It is a useful source for the potential research on the usage of NFT for this specific industry (Anatoli & et al., 2022).

Using such an advanced technology also creates some important legal risks which might be difficult to tackle. In the article created by Jewell (Dan Jewell, 2021) mainly the legality of the NFTs has been analysed. Starting with the main and important point - lack of ownership rights so having NFTs of a physical asset doesn't provide us with the right to own it. Other points such as loss of or damage to the underlying asset, risk of fraud and uncertain regulatory framework are also provided with short information about how to reduce them. Risks mentioned in the article are an important starting point to checkout to successfully enter a completely new market with their NFTs. However, not all of the risks related to the legislation procedure are mentioned. Some of them, such as gambling or insider trading also exist in the market of blockchain and new high-tech technologies. The ownership of the products acquired in the crypto world has been also researched by other people. One of the articles identifies the legal gap - „to what extent the owner is entitled to property rights", even when someone bought his NFT (Wolftheiss, 2022). As it is mentioned, virtual assets do not have the same protection as physical ones. Yet, still this article focuses only on the metaverse and its usage - it does not relate to any potential industry that NFT could represent as an underlying asset.

There have also been many papers related to the economic perspective to perform a systematic review of NFT and suggest some potential for future research. One of them (Bao & Roubaud, 2022) provides several ideas for the analysis related to asset pricing, tokenomics and risk and regulation topics. Even though the ideas provided by the article are mostly related to the broad range of industries, there is no information about going much deeper into the implementation of NFT technology in the existing company in the specific industry. What is more, the number of articles reviewed - 13 (even though they had much higher standards than others) is not enough to fully understand the potential and find all the missing gaps for future research.

Apart from focusing on the real industry aspects of NFT, this topic has been also evaluated from a technical perspective. Provided article (Ante, 2022) takes into account the 14 largest NFT submarkets and analyses them based on several blockchain factors. It shows a useful analysis and even identifies several „wash trading" techniques in those submarkets. However it has still several drawbacks. First of all - it analyses only NFSs from one blockchain, even though there is a huge amount of successful NFT submarkets in others. Secondly, it takes a look only at the data that could be gathered from the blockchain. It does not take any more information from social media (such as the number of tweet posts, etc) - which could give a huge incentive to analyse why a specific project was successful. The paper can provide several ideas to create a follow-up research, for instance analysing the reasons why specific projects in the past were much more successful than the ones created currently, even though the current graphics look much nicer than the previous ones.

The article (Santana & Albareda, 2022) provides broad information about the DAOs that are formed using the blockchain industry. Analysis of the literature also provides the research gaps that are available

for people to solve. What is more, it gives an important overview of the theoretical perspectives that are applied to Decentralized Autonomous Organizations. The paper shows an extensive potential research agenda for more information about the DAO such as an analysis of DAO's applicability and scalability in business, value-creation and business models.

As specified in the introduction part, blockchain solutions already exist in different industries, such as real estate (Moringiello & Odinet, 2022). The article provides extensive information about the blockchain in real estate and NFTs - especially about comparing the existing problematic system with potential solutions from the blockchain. It provides several ideas and current solutions related to the Land transfer by NFT, including loaning the property, crypto-enabled loans and moving the recordings to the blockchain. The paper identifies blockchain as unnecessary - any electronic system that is managed by a government entity could be used to fix the problems related to the industry. However for that to be possible - the regulation has to be updated in some of the countries/states. It realizes several impediments that block the reality of potential changes of the whole industry to the blockchain, being mainly the land. As specified - they find out that the blockchain technology promise in the physical world is very limited, therefore almost useless in the real estate industry. On the contrary, this paper gives an idea of the potential uses for NFTs - enabling the status and access to the custom community groups or receiving exclusive ownership.

Other articles focus on the potential marketing strategies that could be used to improve the sales and recognition of the product by using NFT. For that, they identify materialism, status consumption orientation and consumers' innovativeness as the crucial determinants for people to buy the tokens. It also analyses the correlations between the presented factors. The study could be improved, as right now it is focusing only on those 3 factors while leaving multiple others untouched (Sestino, Guido, & Peluso, 2022). Yet it provides one major point, that one of the motivations to increase people's involvement might be NFT tokens, which they can obtain by participating in the decision-making process.

Last but not least there some papers with a broad evaluation of the potential usage of the NFT tokens have been created. Some of them analyse the NFT solutions from the technical perspective, as well as describe some important opportunities and challenges (Wang et al., 2021). Provided opportunities show a brief potential of an NFT use case in specific industries. However, similarly to many of the articles described above, it is still only an explanation of an idea - not a comprehensive guide on how to introduce it - for instance in the gaming industry, questions like:

- What is the appropriate process for the adoption of an NFT?
- How long would it take?
- What is the framework to structure both the input as well as the output of the organization structure and processes?

should be asked. Specified challenges provide several important points that are necessary to consider while trying to implement the NFT in the existing industry and existing company. To successfully introduce this technology to the industry - all of the considerations should be thought about and the risks should be minimized - both for the future users of the NFTs, as well as the company. The article provides an extensive list of references - both of NFT projects as well as others about the security of the blockchain and potential regulations in this industry.

While blockchain, NFTs, and DAOs have emerged as potential solutions for various issues in different industries, the technology can also be utilized in the public sector. For instance, the use of blockchain and NFTs in voting systems can enhance transparency and reduce voter fraud. However, despite the potential benefits of such technologies, public participation problems still exist in many areas. It is necessary to explore various strategies and initiatives aimed at tackling these public participation issues, drawing insights from the literature review on the subject. What is more, there is still a lack of understanding of how such a solution could be utilized. Technological perspective can provide an important starting point in making sure that we have enough capability to implement such a solution, yet it requires a more organizational understanding of several main points towards its implementation like precautions against 51% attack (Ye, Li, Cai, Gu, & Fukuda, 2018) and centralization/decentralization of blockchain (Sai, Buckley, Fitzgerald, & Le Gear, 2021).

3.4. Tackling public participation challenges

There have been various efforts to tackle the challenges and limitations of the current state-of-the-art public participation methods. One approach has been to increase the use of technology in public participation processes, even though it might exacerbate the digital divide problem (Ellwood et al., 2015). For example, online platforms and social media have been used to reach wider audiences and facilitate engagement with citizens who are unable to attend physical meetings. Another approach has been to increase transparency and accountability in the decision-making process, which can be achieved by providing clear information about the process and outcomes of public participation activities (Seltzer & Mahmoudi, 2013). Additionally, the use of incentives such as financial rewards or recognition can motivate citizens to participate and contribute to the public participation process (Ling, Xu, & Xiang, 2021). The potential of blockchain and NFT technologies in addressing the challenges of public participation is also being explored, as they offer potential solutions for issues such as transparency, accountability, and incentivization.

One of the articles related to public participation in smart city governance (Bai, Hu, Seo, Kang, & Lee, 2022) had the technology architecture and design of blockchain usage in the decision-making process in the city. The approach focuses on improving public engagement through the usage of hybrid blockchain and Stackelberg-game-based incentive mechanisms. The paper presents one of the possibilities of implementing blockchain to engage people in the decision-making process, however, it does not give the people the freedom to fully be involved in the decision-making process and provide the necessary information about the most important issues in the city. What is more, the paper focuses only on the current decision-making process and does not provide any innovative ideas to further increase the involvement of the people towards the city.

Another important article focuses on the usage of blockchain technology in the cities (Treiblmaier, Rejeb, & Strebinger, 2020). It describes briefly 9 application fields, how to make the cities more ‘smart‘ and provides several future research hypotheses for each of them. Even though the paper provides several propositions for all of them, they are not exclusive to the given industry. For instance, e-voting could have more applications than only elections and increase trust. What is more, the paper focuses only on blockchain technology, not on additional tools and frameworks such as DAO or NFT. There is a huge potential for knowledge creation by working on the top of this paper and performing a more detailed explanation towards a specific industry. Moreover, apart from the potential usages, the framework of how to include this technology in cities could make it much easier for cities to adapt and transform to the usage of high-end technologies.

Some of the articles also tried to compare multiple public participation improvement methods with each other (Rowe & Frewer, 2000). Based on the main goals and decisions which are supposed to be undertaken, the article provides a clear way of choosing the appropriate method. Even though they performed a comprehensive approach of several different methods, they did not involve the newest and most modern one which is online platforms. Nowadays, new technologies are in all parts of our life. This is why it is also important to integrate them within public participation and analyze their quality.

Multiple challenges and limitations seem to be possible to be resolved with the usage of thoroughly thought online platforms. Starting with access to technology and the internet, on the one hand, in the current world most people do have access even though if they come from low-income communities, they could visit the municipality or a library to have access. On the other hand, the reason that simple online platforms do not perform well is the lack of appropriate UI/UX and also the lack of incentive to vote. The appropriate design, which could encourage people to vote and provide their ideas, as well as enough support, could lower the problem with the digital divide (JOEducation, 2020).

Even though people are one of the major stakeholders in the entire process, not all of them are incentivised towards sharing their problems. Many of them do not believe that their small vote might change anything. It is especially true when it comes to the immigrants who start living in the country and their cultural differences demotivate them from sharing the problems. What is more, providing more and more incentives, which might be of different types such as purpose-driven, social, status or material might really improve the public participation numbers (Tang, 2005). Those incentives can be also integrated within the blockchain and NFT technologies bringing more opportunities and gamification elements to further increase engagement.

To tackle the time-consuming and logistically challenging methods, freedom of choice is necessary to be provided to people. Citizens should be able to vote or participate in the decision-making process

whenever they want and wherever they want from the safety of their own homes. Being flexible for the citizens, allows them to have more freedom of choice and safety to do it as soon as they have some time to spare. One approach is to leverage technology to facilitate remote participation, such as through virtual meetings or online forums (Nabatchi & Leighninger, 2015). This can make it easier for people to participate, especially those who may not be able to attend in person due to scheduling or transportation issues. Another approach is to use more targeted and focused outreach efforts, such as through targeted social media advertising or targeted mailings to specific communities. This can help ensure that those who are most impacted by a particular issue are more likely to participate.

Last but not least - public participation nowadays is not fully transparent. Even though people might vote, they cannot see how the funds are being transferred and what resources are used. Blockchain and NFT technologies might bring more safety and transparency to the solution (Sunny, Undralla, & Pillai, 2020), allowing people to peek at the hands of the government, to make sure that everything that is on the TV and the platform, is reflected in the funds being distributed between the stakeholders.

To tackle multiple challenges and limitations, a specific application has to be developed. One potential application can be blockchain technology in the area of public participation in local government decision-making. By leveraging the transparency and immutability of blockchain technology, cities can create a more secure and widely available process for community members to participate in the decision-making process and create awareness about problems in the city. What is more, NFTs can be used to create a unique digital identity for each issue, making it easy for citizens to track and follow the progress of their reported issues. The more NFTs of a particular issue have been bought, the more important is the proposed issue for the community. The usage of NFT's cities can create a more inclusive and engaging process for community members to participate in the decision-making process. Blockchain technology, especially when paired with NFTs, can provide transparency, security, and traceability, which can foster trust and accountability between the citizens and local government.

The online platform, based on the technologies like blockchain and NFT with additional parts related to gamification and incentivisation might create an immersive experience for people, bringing more and more of them towards the public participation world. Having one place, where everyone can see the issues and provide them to the public with immediate information about their status, whether they have been resolved, analysed and how many resources have been used to tackle those creates an enormous information platform so that all of the citizens will feel engaged and part of the process.

Finally, it is important to notice, that even though from the technological perspective, the blockchain seems like a viable solution to utilize, it still requires some more research related especially to the usage of it. There have not been enough examples of Pilot projects in different cities, explaining the current results as well as taking security and decentralization measures that this research could be built upon it. Understanding this important limitation is a necessity in further evaluating any possibility of using blockchain in public participation projects.

Challenges and Limitations	Solution
Not everyone has access to technology	Public access points in the library or municipality
Time-consuming and logically challenging meetings	Online access without setting up meeting with all information available for the people on the internet
Costly to establish	Lack of hiring experts, instead infrastructure and energy expenses
Exclusive group access	Everyone has access to the same platform, without more privileges
Transparency	Built-in the blockchain solution

Table 3.1: Tackling challenges and limitations

3.5. Conclusion

The literature review reveals that traditional methods of public participation continue to dominate, with limited adoption of digitalized approaches. Those methods still have multiple challenges and problems, which new

multiple technologies might try to tackle and be the way to overall improve citizen participation. Concept of the e-governance mostly focuses on introducing digital technologies and overall digitalization towards public participation. Taking benefits from main characteristics like global reach, speed and statistics are several reasons why multiple governments try to utilize this approach. While e-governance has provided a conceptual framework for incorporating technology in public participation, there is a noticeable gap in addressing the specific challenges and opportunities presented by emerging technologies like blockchain.

Although blockchain holds great promise in addressing issues of trust, transparency, and citizen engagement, there is still a lack of research on its potential usage in the context of public participation. Usually, many of the reports had provided more technology architecture and approach towards tackling the decentralized autonomous approach, but there is still not enough information about the real-life usage. The existing literature highlights the need for further exploration and investigation into the practical implementation, benefits, and limitations of blockchain technology for enhancing public participation. By bridging this research gap, policymakers, governments, and stakeholders can better understand the potential of blockchain as a transformative tool for fostering inclusive, transparent, and effective public participation processes.

4

Data Collection

The purpose of this study was to evaluate the opportunities and challenges of new technologies (especially blockchain) in promoting public participation and decision-making in Delft, as well as to identify ways to increase citizens' involvement in creating awareness about the problems in the city. To achieve this, a mixed-methods approach has been employed that involved conducting interviews with government officials and blockchain experts, and administering surveys to citizens of Delft.

In this chapter, results of the data collection efforts are presented, which provide insights into the perceptions and experiences of key stakeholders regarding the needs and opportunities for new technologies for promoting public participation and decision-making in Delft, as well as the barriers and facilitators that need to be addressed to realize their full potential. Apart from the interviews with the government officials and blockchain experts, the report on the responses of citizens of Delft to the survey questions has been created, which shed light on their awareness of the problems in the city, their views on the effectiveness of existing channels for public participation, and their interest in using other tools to enhance their engagement with civic issues.

By presenting the findings of the data collection methods, the research aims to provide a comprehensive understanding of the opportunities and challenges associated with new technologies for promoting public participation and decision-making in Delft and to contribute to the development of different strategies and ideas for increasing citizens' involvement in creating awareness about the problems in the city. The information gathered through the data collection process is a main milestone, which together with the literature review could advise on further framework and steps of the desired solution which can improve and enhance the public participation process not only in Delft but also in other cities.

4.1. Data from government officials

Given the significance of political parties in shaping public policies, all political parties in Delft were contacted and invited to participate in this study. In addition, several government officials who play a key role in implementing policies related to public participation and decision-making were also contacted. While some government officials readily accepted the invitation and provided valuable insights, not all political parties responded to our request or agreed to participate in the study. The insights that have been gained from the 6 different government officials and politicians who did participate provided valuable perspectives on the current practices of public participation and decision-making in Delft, including the main pain points, that they would like to address in the nearest years.

Some of the interviews were conducted face-to-face, while others were online and lasted between 20 minutes to one hour. The purpose of the interviews was to gain insights into the current practices and challenges of public participation and decision-making in Delft and to understand the opportunities and challenges of using new technologies in this context. Some of the political parties provided useful resources and documents related to their pain points in public participation and the ways that they engage with citizens. These resources included policy documents and reports, which helped to contextualize the challenges faced by political parties in engaging with citizens. These resources were used to supplement the insights gained from the interviews with government officials, thereby providing a more comprehensive picture of the current state of public participation and decision-making in Delft. Information about the government official respondent profile is presented below:

Interviewee	Description and experience
Interviewee 1	Municipality Official - experience and responsibilities related to public participation
Interviewee 2	Political Party Leader - organization of multiple meetings with citizens
Interviewee 3	Political Party Member - participating in the city council
Interviewee 4	Government Official - handling public participation
Interviewee 5	Political Party Member and Member of the Council - participating in the city council

Table 4.1: Government Official Respondents

Additionally insights were gathered from the municipality point of contact - by getting both the answers to the questions as well as additional documents that have not been found during the literature review.

4.1.1. Current state of public participation in Delft

Starting with the current state of public participation in Delft, there still remain several significant gaps in the system. The politicians try to use social media platforms like Instagram as an advertisement tool for any upcoming meetings and events, as well as attempt to meet with community representatives in person. However, these efforts are not always successful in reaching all members of the community, and some citizens may feel excluded from the decision-making process. Furthermore, the government lacks a system to track how many initiatives have been proposed by citizens, and they do not have any useful feedback on the outcomes of these initiatives. This makes it difficult to evaluate the effectiveness of public participation efforts and identify areas for improvement. Finally, the easiest and only way to provide feedback to the government or the political party is through email. The citizen who sent some information to the municipality is not fully informed of the follow-up of his/her feedback and whether any actions are going to be undertaken. Overall, while some efforts are being made to encourage public participation in Delft, there is still much work to be done to make the process more inclusive, transparent, and effective for all members of the community.

The currently used methods of public participation face several limitations that hinder the effectiveness of the process. One of the limitations is the **lack of statistical data**, which makes it challenging for the government to evaluate the impact of the public participation process. One of the leading causes for it was pointed out as digitalization: *We struggle with the use of digitalization.* (05.2023, Interview with Government Official). Additionally, the **limited reach of the citizens** is also a significant constraint, as not everyone is aware of the initiatives or events happening in their community, especially if they cannot participate when they want. Many of the respondents pointed out that: *People do not have time to physically participate in meetings!* (05.2023, Interview with Government Official). This can lead to a lack of diverse perspectives and can ultimately result in a limited representation of the citizens' interests - especially if only a highly educated group of people is participating in the meetings. What is more, people do not want to participate, as *Not all the groups feel represented in the town hall meetings!* (05.2023, Interview with Government Official). Another limitation is the **lack of incentivization**, which makes it difficult to motivate citizens to participate actively in the public participation process. Without incentives, citizens may not have sufficient motivation to invest their time and effort in the process, which could lead to a lack of engagement and less diverse perspectives. These limitations highlight the need for more effective and accessible methods of public participation that can overcome these challenges.

Through the interviews conducted with government officials, several key challenges were identified in relation to public participation and decision-making. Among the main challenges mentioned was a sense of **mistrust in government institutions**, which has eroded public confidence in the decision-making process. Some of the respondents mentioned specifically that: *People do not trust the government!* (05.2023, Interview with Government Official). Many citizens feel that their voices are not heard and that the government is not responsive to their needs and concerns, as well as it is not transparent enough and that there is a lack of accountability in decision-making. This can lead to a sense of alienation and a

belief that their input will not be taken seriously or acted upon. This mistrust is seen as a major obstacle to promoting meaningful public engagement in decision-making processes.

This can easily lead to **lack of motivation** among citizens to participate in decision-making processes, which has limited the scope and impact of public participation initiatives in the city. Both lack of interest from people, as well as lack of time and access (when people cannot participate whenever they want), hinders the possible participation from many people who works normally throughout the day. The main problem here is that people who are not directly affected by the given decision (at least in their understanding), do not have any incentive to participate. It has been identified that something called *Grey Mass* can describe some of the citizens: *Grey mass - my life is good, my neighbourhood is good but only when I am directly affected I will participate!* (05.2023, Interview with Government Official). It is also a very tough task, to identify both the direct and indirect relation - for instance, removing the cinema in one region of the city might increase the use of the cinemas in other regions, which increases the traffic in those areas.

Finally, the officials mentioned concerns around **privacy issues**, specifically around the use of data and information obtained through public participation initiatives. This was seen as a significant concern that could hinder participation from citizens who are wary of sharing personal information. In order to further incentivise participation, people should not worry about the security of their data, as well as its usage and be fully satisfied with all the measures taken to protect their privacy in public participation.

Overall, these challenges will need to be addressed in order to promote greater public participation and decision-making in Delft. Coding and thematic analysis have been used to better present the data of the data collection method. The following table presents the list of codes and appropriate themes for both the challenges from the government officials.

Codes	Theme
Lack of transparency	Mistrust in government
Lack of accountability	
Unresponsiveness	
Public awareness	Privacy issue
Data collection and usage	
Data security	
Lack of interest	Lack of motivation
Lack of time and access	
Lack of knowledge	

Table 4.2: Thematic Analysis - Current Challenges

4.1.2. Needs and opportunities for improvement

The interviews with government officials and experts revealed several potential opportunities for improving public participation and decision-making in Delft. The first opportunity identified was the need for greater **availability** of information and resources related to public participation. A solution that provides easy access to relevant information and resources would help citizens to make more informed decisions and participate more effectively in the decision-making processes. Additionally, such a solution could promote greater transparency and accountability in decision-making processes by ensuring that citizens have access to relevant information.

Privacy was also identified as an important issue that needs to be addressed in order to promote greater citizen engagement in public participation initiatives. A solution that ensures the secure and private handling of personal information could help to address these concerns. It could also help to build trust in government and increase citizen participation in public initiatives.

Another opportunity for improvement was the need for a **two-way communication** between citizens and government officials. This would enable citizens to not only provide input but also receive feedback and responses from officials. A solution that facilitates such a dialogue could help to improve the transparency and accountability of decision-making processes. It would also provide citizens with a sense of ownership and engagement in the decision-making process.

Finally, **digitalization** was identified as a key factor in enhancing public participation and decision-making in Delft. A solution that incorporates digital technologies could help to improve the efficiency and effectiveness of decision-making processes while also promoting greater citizen engagement and participation. This could include online platforms that allow citizens to participate in decision-making processes or mobile applications that enable citizens to provide feedback on public initiatives. Such a solution could help to increase citizen engagement and promote a more inclusive decision-making process.

Codes	Theme
Easy to reach	Availability
Focus on User Experience	
Available all the time	
Confidentiality	Privacy
Data security	
Feedback-driven	Two-way connection
Conversational	
Online	Digitalization
Digital	
Automated	
Virtual	

Table 4.3: Thematic Analysis - Opportunities and needs

4.1.3. Possible incorporation of new technologies in Delft

Government officials mentioned multiple times the possible incorporation of new technologies, which could bring several benefits to the current system in public participation. Firstly, they would provide a **global reach** to people in the community, enabling citizens from all Delft to participate and contribute to the decision-making process in their city. This can lead to more diverse and inclusive input, allowing for a wider range of perspectives to be taken into account. Secondly, new technologies can **simplify access** to information, increasing transparency and trust in the decision-making process. By providing open access to data and information, citizens can better understand the rationale behind decisions, leading to greater support, participation and feedback. Thirdly, these technologies have the potential to **unite the community** with each other, allowing citizens to connect with like-minded individuals and together form societies striving for similar goals. This can lead to increased collaboration and engagement in public affairs, and ultimately, a more vibrant and involved community, which can expect constant communication with government officials.

Codes	Theme
All citizen can participate	Global Reach
Easier possibility to contact citizen	
Access to a wider audience	
One place for all the problems	Simplify access
Reduced barriers to participation	
People can participate together	United community
Easier communication with government	
Collaborative decision-making	

Table 4.4: Thematic Analysis - Benefits of incorporation of new technologies

Several challenges of the incorporation of new technologies have been mentioned which can make engaging with the public online tough for a number of reasons. One major challenge is the **digital divide**,

which refers to the gap in access to technology between different groups in society. Not everyone has equal access to the internet or digital devices, which can limit their ability to participate in online discussions or use online tools for engagement. Another challenge is **privacy concerns**, which can be particularly acute when discussing sensitive or controversial issues. Citizens may be reluctant to provide personal information or express their opinions online if they are concerned about their privacy being compromised. **Technical difficulties** can also pose a significant challenge, particularly for older or less tech-savvy citizens who may struggle with using online tools or platforms. These challenges must be taken into account when designing online engagement strategies to ensure that they are accessible and inclusive for all members of the community.

Codes	Theme
Limited internet access	Digital Divide
Not everyone has electronic devices	
Data security	Privacy Concerns
Compromisation of privacy	
Poor user interface	Technical difficulties
Limited computer skills	
Lack of accessible platform for everyone	

Table 4.5: Thematic Analysis - Challenges of incorporation of new technologies

4.1.4. Necessary steps for incorporating new technologies

The government officials also provided several steps on how to incorporate the usage of new technologies to better engage with the public online. First, it's crucial to understand the needs and requirements of citizens when it comes to user experience and user interface. This involves conducting thorough research to determine what features citizens would like to see and how they prefer to interact with the platform. Second, it's important to talk to all the stakeholders involved in the public participation process, including government officials, community leaders, and citizens. By understanding the different perspectives and priorities, municipalities can create a new process that meets the needs of all parties involved. Third, extensive research should be conducted with the citizens to collect ideas, feedback, and proposals related to the public participation process. This information can be used to guide the development of the online platform and ensure that it meets the needs of the community. Fourth, the main and crucial plan has to be developed. Additional external experts might be necessary to take into account as much information as possible and provide the most comprehensive platform for people. What is more, training for both the municipality staff, as well as a citizen, is necessary. If it is a new process using new technologies or a platform, both solutions would require sufficient training for the people managing and using it. Sixth, the appropriate migration plans should be made for any current public participation processes that exist, ensuring that they are seamlessly moved to the online platform. When the platform is launched, a huge marketing campaign about the new process should be created to inform all of the citizens in the city about the new functionalities and features which citizens can use. The process should be continuously improved by getting feedback from the citizen and analysing the data gathered through the platform. Last but not least, municipalities should ensure that the platform is designed with transparency and accountability in mind, providing clear information on how citizen input will be used, how decisions are made, and how feedback is incorporated. With these steps in place, municipalities can effectively leverage new technologies to engage with the public online and create a more inclusive and effective public participation process.

Proposed process:

1. Understand the needs and requirements of citizens
2. Talk to all the stakeholders involved in the public participation process
3. Collect ideas and proposals for the current public participation processes from the citizen
4. Develop the plan for the new process
5. Provide training to the municipality staff and citizens about the new process
6. Prepare migration plan for the current public participation processes

7. Launching marketing campaign about the new process to the citizen
8. Collect feedback for continuous improvement of the process

4.2. Data from blockchain experts

In addition to the data collected from government officials and politicians, similarly, 6 different blockchain experts have been interviewed. The experts were asked about their views on the potential of blockchain technology to improve the relationship between citizens and government. Multiple additional documents and reports have been obtained from the researchers, including several case studies. List of respondents is presented below:

Interviewee	Description and experience
Interviewee 1	Blockchain Expert - 2 years working experience in the blockchain industry
Interviewee 2	Cryptocurrency Expert - experience working in blockchain and created own cryptocurrency
Interviewee 3	Blockchain PhD - working and researching future solutions using the blockchain technology
Interviewee 4	Blockchain Laboratory Member - multiple years of experience developing new blockchain technology solutions
Interviewee 5	Cryptocurrency Research Group Leader & Member of the Organisation for Economic Co-operation and Development - participant in e-governance solutions, including e-participation
Interviewee 6	Blockchain Expert - experience creating NFT solutions

Table 4.6: Blockchain Respondents

Some of the experts were convinced that blockchain technology has the potential to revolutionize the way that government interacts with citizens. They pointed to the two main potential benefits of blockchain technology: *Huge increase in security and out-of-the-box transparency!* (05.2023, Interview with Blockchain Expert).

1. **Transparency** - Blockchain technology is inherently transparent, as all transactions are recorded on a public ledger. This could help to improve trust between citizens and government, as citizens would be able to see how the decisions are made, as well as what is their follow up.
2. **Security** - Blockchain technology is very secure, as it is based on cryptography. This could help to protect citizens' data from fraud and theft as well as improve privacy in e-governance.

Similarly to the data gathered from government officials, coding and thematic analysis have also been used to better present the main points and results of the data.

Codes	Theme
Public ledger	Transparency
Immutability	
Auditability	
Cryptography	Security
Decentralization	
Privacy	

Table 4.7: Thematic Analysis - Blockchain opportunities

4.2.1. Blockchain opportunities for public participation

Blockchain and NFT technologies have the potential to tackle some of the challenges and limitations of the current public participation methods. For example, blockchain technology could **increase transparency and accountability** in the decision-making process by providing a secure and tamper-proof record of all transactions and decisions. This could potentially increase trust in the government and the public participation process. Additionally, NFTs were pointed out as a useful tool for **incentivizing citizen participation** by offering unique digital assets as rewards for participation. Some of the experts claimed that: *NFT together with gamification could be used as an interesting incentivization for the citizens!*. What is more, decentralized autonomous organizations (DAOs) can be used to further **unite citizens** into participating together. However, it is important to note that these technologies are not a panacea and come with their own set of challenges, such as the need for technical expertise.

Blockchain and NFT technologies have several potential benefits in public participation, such as increased transparency, immutability of records, and enhanced security. These technologies can provide a decentralized platform for citizens to participate in decision-making, reducing the risks of manipulation and corruption. However, the use of blockchain and NFT technologies also comes with limitations and potential risks, such as technical complexity and the lack of accessibility for some citizens. Additionally, the high energy consumption required for the operation of blockchain networks is a growing concern for environmental sustainability.

There are several potential use cases and applications of blockchain and NFT technologies in public participation and decision-making in cities. As mentioned before, blockchain can be used to increase the transparency and accountability of the decision-making process by providing a secure and immutable record of all transactions and decisions. This can help to build trust between citizens and government officials. A secure and transparent platform for citizens to engage with and influence their government could further enhance public participation. For example, a blockchain-based voting system (like DAO) could allow citizens to cast their votes on important issues in a secure and tamper-proof manner, increasing trust in the democratic process. NFTs can also be used to provide citizens with a tangible representation of their participation in the decision-making process, such as digital badges or tokens that can be exchanged for benefits or rewards.

Blockchain and NFT would have to be tailored to the specific needs of the community by involving citizens in the development and implementation process. For example, community members can be invited to participate in the design of blockchain-based voting systems or NFT-based reward programs. It is also important to ensure that the technologies are accessible to all members of the community, regardless of their level of technical expertise or access to technology. This can be achieved by providing training and support, as well as ensuring that the technologies are user-friendly and intuitive to use. Overall, blockchain and NFT technologies have the potential to revolutionize public participation and decision-making in cities and can be tailored to the specific needs and preferences of each community.

4.2.2. Risks and challenges of blockchain

There are still several risks and challenges of blockchain. One concern is the potential for technological barriers that could limit participation from those who lack access to technology or the necessary skills to use it. Blockchain technology, with its requirement for specialized knowledge and infrastructure, could even exacerbate the problem of the digital divide. What is more, even though blockchain technology is protected with cryptographic algorithms, one small mistake within the implementation of the platform can lead to major problems within problems. Additionally, there are concerns about the environmental impact of the energy-intensive processes used to mine and process blockchain transactions.

To address these concerns, it is important for municipalities to prioritize accessibility and user-friendliness in the design of their blockchain and NFT-based public participation platforms. This may include providing training and support for citizens who are less familiar with these technologies, as well as developing interfaces that are easy to use and navigate. Additionally, strong security measures should be put in place to protect the privacy and data of participants, and efforts should be made to mitigate the environmental impact of blockchain mining. By taking these steps, municipalities can ensure that the use of blockchain and NFT technologies in public participation is safe, secure, and accessible to all members of the community.

4.2.3. Introduction of blockchain technology in the city

To work with other jurisdictions and organizations to introduce the blockchain in the city, the municipality could participate in conferences, workshops, and other events related to blockchain and NFT technologies. This would allow them to connect with other professionals in the field, share knowledge and best practices, and learn from the experiences of other municipalities. It could also establish partnerships with other organizations that are using or planning to use blockchain and NFT technologies in public participation, allowing for even bigger collaboration and knowledge-sharing.

The municipality can also work with community groups and organizations to design and implement blockchain and NFT technologies for public participation in the local government decision-making process by engaging in open and transparent communication. This involves actively seeking out community input, engaging in dialogue, and collaborating with community groups and organizations to co-design solutions that meet the specific needs and concerns of the community. The municipality can also establish partnerships with local tech companies and universities to access expertise and resources in designing and implementing blockchain and NFT technologies. Additionally, they can organize workshops, training sessions, and community events to educate citizens about these technologies and how they can be used to promote public participation and decision-making. By working together with community groups and organizations, the municipality can ensure that the use of blockchain and NFT technologies is inclusive, accessible, and equitable.

Last but not least, to evaluate the success of their implementation, the municipality can consider several metrics, such as the number of citizens participating in the decision-making process, the quality and diversity of the proposals submitted, and the level of satisfaction and trust among citizens. The municipality can also monitor the efficiency and cost-effectiveness of the new technologies compared to the previous methods of public participation. In addition, they should conduct surveys and collect feedback from citizens to continuously improve the user experience and address any concerns or issues that arise. Nevertheless, several experts strongly advised that: *Use case is great - yet the technology is too early in the process*.

4.2.4. Reality of blockchain

All of the above information suppose that people are already capable of developing a blockchain platform, that could be easily used by people, fully transparent with no security problems and any possibility of tampering in the city. However, multiple blockchain experts together agreed to the fact, that the blockchain is not ready yet to be adapted - *Technology is great - yet for sure not fully researched to be used for public participation!* (05.2023, Interview with Blockchain Expert). There are many different research that still need to be understood and analysed, to start preparing this platform and create the necessary infrastructure for it. Starting with the majority of the network and making sure that none of the parties has 51% of the network, which would allow them to easily manipulate the results of any possible voting in the network. What is more, the way of providing policies that would enforce digital voting to be taken into account as if they were offline would have to be introduced. There would need to be a party that would analyze the results and somehow govern and make sure that the decisions taken on the platform would be implemented, making it a more centralised solution instead of the decentralized one. What is more, another research related to privacy and advanced security is necessary. How to safely enable people to talk to politicians and provide their feedback without being identified and punished is important. Those are only several main reality issues that were exposed by blockchain experts which make it even impossible from their perspective to start implementing platform solutions.

4.3. Data from citizens

Moving to the data collected with the survey, it was conducted among more than 80 citizens of Delft and provided valuable insights into their current pain points, as well as their ideas and needs for improving public participation and decision-making processes. The people that have filled in the survey are in the group aged between 18 and 30, and their current status is a student or young professional. Summation of the survey respondent profile is presented in the following table:

Demographic	Percentage/Description
Size	80 people
Age Group	18-24: 70%, 25-30: 30%
Education Level	High school: 5%, Bachelor degree and higher: 95%, (Most of the people bachelor's degree/finishing master's degree)
Occupation	Students/Looking for a job: 95%, Professionals: 5%
Geographic Location	Delft: 100%

Table 4.8: Survey Respondent Profile

In addition to the pain points and improvement ideas, the survey results revealed a significant gap in public awareness regarding the decision-making process in the city. Shockingly, over 80% of the respondents were **not aware** of the whole process. This finding underscores the need for more education and outreach initiatives to increase citizen participation and engagement in the decision-making process. The diagram is presented in the appendix A.1.

Furthermore, the survey also revealed that the majority of respondents were dissatisfied with the current opportunities for public participation and believed that their **voices were not being heard**. Some expressed frustration and disappointment that their complaints and suggestions were not being taken seriously and that they felt their issues were being swept under the rug. This sentiment was echoed by several participants in the survey and was also mentioned in some of the interviews with government officials. This lack of trust in the government's willingness to listen to citizens' concerns and ideas is a major barrier to improving public participation and decision-making. The diagrams expressing how people are informed A.2 and whether they are aware of the opportunities that are available in Delft A.3 are provided in the appendix.

Another major pain point identified by citizens was the **lack of opportunities** for meaningful participation and **feedback** in decision-making processes. Many respondents felt that their input was not being heard or valued and that decision-making processes were being driven by external factors rather than citizen input. Several respondents expressed a desire for greater opportunities to participate in decision-making processes and to have a greater say in the future of their community. What is more, many people expressed that they are **not aware** of any possibilities of providing feedback to the city. The corresponding diagram is attached in the Appendix A.4.

Despite these pain points, citizens also offered several ideas and needs for improving public participation and decision-making processes. One common theme was the need for greater transparency and accountability in decision-making processes. Many respondents expressed a desire for more information about the decision-making process and greater access to decision-makers. What is more, they mentioned that those features are extremely important in the decision-making process, which would further incentivise them to participate in it. Additionally, several respondents suggested the use of technology to improve transparency and increase citizen engagement, such as online platforms for citizen participation and feedback. The diagrams expressing the importance of transparency and accountability are attached to the Master Thesis A.5.

While **ease of participation** was mentioned as an important point by some survey respondents, it was clear from the data collected that transparency and accountability were seen as more critical to improving public participation and decision-making in Delft. Participants expressed a desire for greater visibility into the decision-making processes and for more open communication channels between citizens and

government officials. Many respondents felt that the current system was opaque and difficult to navigate, which made it hard for them to participate fully in the democratic process. In contrast, some participants felt that making the process easier without addressing the underlying transparency and accountability issues would not be effective in increasing public participation. Therefore, while the ease of participation is an important factor to consider, it is clear from the data that transparency and accountability are viewed as more fundamental to building a stronger, more participatory community in Delft. The diagram created from the survey responses confirms it in the A.6.

Many survey respondents expressed a desire to be **better informed** about the decisions made in the city which is presented in the following figure A.7. They emphasized the need for more accessible and detailed information on upcoming decisions and ongoing processes, as well as the outcomes of decisions that have already been made. Being informed was seen as essential for citizens to participate meaningfully in decision-making processes and to hold government officials accountable for their actions. However, while being informed was important to many respondents, it was also clear from the data collected (similar to the ease of participation) that transparency and accountability were still viewed as more critical. Participants stressed that being informed alone was not enough and that citizens needed to have a say in decision-making processes and be able to hold government officials accountable for their actions. Therefore, while being informed is a crucial aspect of public participation, it is evident from the data that transparency and accountability remain the top priorities for improving public participation and decision-making in Delft.

Last but not least, provisioning of **anonymous feedback** was suggested by some respondents as a potential solution to overcome barriers to public participation, such as fear of retaliation or stigma. Participants emphasized the need for a safe and secure channel for anonymous feedback, where citizens could provide honest and open feedback without fear of consequences. While the possibility of anonymous feedback was viewed as an important aspect of public participation by some respondents, it was not considered as critical as transparency and accountability. The data indicated that citizens believed that transparency and accountability were essential for building trust between citizens and government officials, and for ensuring that decisions made by officials were fair and just. While providing anonymous feedback could increase citizen participation, it would not solve the underlying issues related to transparency and accountability. Therefore, while the possibility of anonymous feedback is important, it is not viewed as a top priority for improving public participation and decision-making in Delft. The presented diagrams show how the citizens value the provisioning of anonymous feedback to the city A.8.

On a positive note, the survey results also provided insight into the types of public participation mechanisms that citizens are most interested in. The thematic analysis of the open-ended questions revealed several important points. The most common theme among the responses was the need for **digitalization** and online participation options. Many respondents mentioned that they would like to see a more user-friendly digital platform that would allow for easy participation in decision-making processes. Additionally, several respondents mentioned the need to see the outcome of the votes in order to further understand that their voice could make a difference. This would increase **transparency and accountability**, as well as encourage more participation. Another important point that was mentioned several times was the need for **transparency in the money transfer** and *Public Budget* (05.2023, Survey Response). Respondents wanted to see how the city was spending the budget and how their tax money was being used. Additionally, many respondents mentioned the importance of **uniting with other people** so they could participate in the community together and provide together *Feedback* (05.2023, Survey Response) to the municipality. Finally, some respondents suggested that **input from experts** should be taken into account when making decisions, especially those related to the given domains related to the undertaking decisions. Additionally, people have expressed several main points for the mechanisms, which should focus on the concepts like: *Ease of voting* and *Possibility to participate online* (05.2023, Survey Response). Overall, these responses reveal a strong desire for increased transparency, citizen collaboration, expertise and digitalization in the decision-making processes in Delft.

Codes	Theme
App	Digitalization
Online	
Digitalization	
Transparent voting	Transparency
Seeing results	
Money transparency	
Understand if voice can make a difference	Citizen collaboration
Uniting with other citizen	
Collaboration with others	
Bring experts	Expertise
Knowledgable people to help with the decisions	

Table 4.9: Thematic Analysis - Other public participation mechanisms provided by the citizens

The survey responses also revealed some common desires among citizens for changes to the current system of public participation. As also shown above, many respondents expressed a desire for more **digitalization** and online options, such as the use of external applications and platforms to facilitate communication with the government. Having *application for citizens* to *report any fixes possible* (05.2023, Survey Response) has been extensively mentioned in the data collection process. What is more, having all of the *necessary information from everywhere* and the possibility to participate online is necessary to include everyone in the voting. Additionally, the need for **multiple languages** was mentioned as a way to better serve the diverse population of Delft. Furthermore, there was a desire for more information and transparency, with many respondents suggesting the need for more **advertisements on social media and other channels** to ensure that citizens are well-informed about the opportunities for public participation. These findings suggest that the citizens of Delft are interested in taking an active role in their community but require more accessible and convenient ways to do so. Therefore, any proposed solutions should prioritize the use of digital tools and should aim to provide clear and easily understandable information to all citizens, regardless of their language or level of education.

Codes	Theme
Online	Digitalization
Platform	
External application	
Easy access through website	
More advertisements	Information
More information	
More online data	
More information sent through emails	
More multi-language information	

Table 4.10: Thematic Analysis - Common desires by the citizens

The citizens' responses regarding the ways to incentivize them to participate more in the public decision-making process indicate that **digitalization**, **easier communication**, and a **simplified process** could be useful motivators. People additionally mentioned several times that there is no *Information how it works* and *Information how to provide the feedback to the city*, which hinders their possibility for participation. They would like to see a more user-friendly and accessible digital platform, making it easier to participate from home or work whenever they have time. What is more, many people mentioned that they *would like to see that their decision matter*. Providing more communication and information towards the citizens might create a sense of accountability and show citizens that their decisions matter. Another suggestion

was to offer **incentives**, such as benefits to be used within the city, to encourage greater participation. In general, it seems that citizens desire greater involvement and a more tangible impact on decision-making processes in their city, and they believe that providing clear incentives and a more user-friendly platform could be a significant factor in achieving this goal.

Codes	Theme
Online	Digitalization
External application	
Website and platform	
Easier process in the app	
More communication	Information
More information	
Any benefits for participating	Incentives
Benefits to use within the city	

Table 4.11: Thematic Analysis - What would encourage people to participate more

Overall, the data collected from the citizen survey provided valuable insights into the current pain points and needs of citizens in Delft regarding public participation and decision-making processes. These insights can be used to inform the development of solutions that are more responsive to citizen needs and more effective in promoting greater citizen engagement and participation in decision-making processes.

4.4. Summary

Overall the data collection process provided multiple points. First of all, many citizens do not trust the government. There is a lack of motivation and usually, only people directly affected by a given decision will consider participating in the decision-making process. Delft needs improvement in multiple areas such as digitalization, availability as well as two-way connection giving both the policymakers as well as the citizen's way to connect with each other. Citizens also expressed multiple needs in the context of new applications or digitalization of the process. They feel that there is not enough information shared between them and they do not feel incentivized to the decision-making process. More collaboration, transparency, incentives and a much easier process are several of the main ways to encourage people from different areas (not only directly affected but also indirectly affected) to participate more.

New technologies might still create several difficulties and increase barriers in society such as the digital divide and privacy concerns. Any introduction of a new solution or approach should take those concerns into consideration and make adapt to make the resulting platform as inclusive as possible. Even though blockchain technology can significantly help in the points like transparency and security, there are multiple risks and concerns about it. Specialized knowledge, the digital divide as well as environmental effects are several challenges that have to be taken into account while evaluating the possibilities of using this technology as a way to tackle the problem of public participation. Nevertheless, blockchain technology still requires much research before its adaptation. Understanding who owns the majority of the network and whether the proposed approach is really decentralized, moving the digital votes into reality as well as increasing the transparency and making sure that there are legal regulations that could enforce that digital decisions are also taken in the offline world are only several points that have to be evaluated beforehand. What is more, research about the potential privacy issues and other governments trying to manipulate the votes within the society creates additional threats that make this technology very hard or even impossible to adapt currently.

5

Analysis & Results

The purpose of this chapter is to analyze and present the findings from the literature review and data collection process. It aims to provide a comprehensive summary of the data collected through surveys, interviews, and literature reviews, and to offer insights into the implications of these findings. The research focused on exploring the perceptions, experiences, and opinions of participants regarding the use of blockchain technology in enhancing citizen engagement and participation in decision-making processes. By analyzing the collected data, this chapter aims to shed light on the potential benefits, challenges, and limitations associated with the implementation of blockchain technology in the context of public participation for all the stakeholders directly or indirectly affected in the process. The section will begin by providing a summary and main findings of the data collection methods. Afterwards, the results of the thematic analysis are presented, drawing upon both the literature review and data collection process. Finally, the chapter will conclude with a discussion of the implications of the findings, including their significance for the research questions and objectives, and their contribution to the broader field of study.

5.1. Data Summary

Based on the data collected through surveys, interviews, and literature review, it can be concluded that there is significant interest and potential for using blockchain technology in public participation and decision-making processes in cities. Citizens expressed a desire for more transparent and accountable methods of participating in government decision-making, while blockchain experts and government officials recognized the potential of blockchain to increase accessibility and trust in these processes. However, there are also concerns related to the technical challenges, privacy, and the digital divide that need to be addressed when implementing blockchain-based solutions. Overall, there is a need for multi-agent collaboration and further research to ensure that blockchain and other new technologies are integrated in ways that best serve the needs and interests of citizens and promote effective public participation in decision-making. The literature review revealed several best practices and potential use cases for blockchain in public participation and decision-making in cities, which can inform future research and implementation efforts. What is more, several cases like the Active Citizen (Holder, 2017) app show the need for blockchain in society.

The following sections of this thesis present the results of the data analysis from the surveys, interviews, and literature review related to the use of blockchain and NFT technologies in promoting public participation and decision-making in the city of Delft. The purpose of that section is to present the key themes and patterns that emerged from the data analysis and to provide insights into the opportunities and challenges associated with the use of these technologies. The analysis was guided by the research questions and objectives outlined in the earlier chapters. The sections will present the major themes and sub-themes that emerged from the data analysis and provide the main results and interpretation that has been discovered from the research.

5.2. Key Stakeholders

The studies have identified three key stakeholders in the realm of public participation and blockchain technology. The first group encompasses government officials and policymakers who hold influential roles in designing and implementing public participation processes throughout the given municipality or a bigger region. These stakeholders are critical in shaping the decision-making landscape and determining the

feasibility of integrating blockchain technology within existing systems. Additionally, they are capable of introducing any changes towards the improvement of public participation, so that more people could participate and share their opinions. The second group consists of citizens and individuals directly impacted by decisions resulting from public participation. Their active engagement and input are vital for ensuring the fairness and inclusivity of the decision-making process. Lastly, the third group consists solely of e-governance experts and researchers specializing in blockchain technology. These individuals possess a deep understanding of the technical aspects and applications of emerging technologies in enhancing governance, especially public participation.

5.3. State of the public participation

In order to explore the current state of public participation in the local government decision-making process in Delft, data was collected through a combination of surveys with citizens and interviews with government officials, as well as a thorough literature review on the topic of public participation. The findings reveal a number of key insights into the current state of public participation in Delft.

Firstly, it was found that while the municipality has made efforts to involve citizens in decision-making through traditional methods such as public hearings and town hall meetings (Delft, 2022a), there is a general lack of awareness and participation among the wider population. According to the survey results, only 16% of respondents reported being even aware of the decision-making process. This suggests that there is a need for more education and more accessible forms of public participation to be developed. Also, through the round of interviews, it has been discovered that such a small number of respondents might also relate to multiple problems existing within the city. First of all, there is mistrust in government institutions, lack of motivation as well as there are privacy issues about sharing any the information with government.

While the municipality has been using Instagram as a tool to reach a wider audience (Delft, 2022a), the survey did not show significant results in terms of public participation through this platform. There may be a lack of marketing campaigns within the platform to promote the municipality's initiatives and encourage citizen engagement. Social media platforms such as Instagram have become one of the easiest tools to reach young people nowadays. Therefore, a more targeted and strategic approach with engaging videos and pictures may be necessary to leverage the potential of Instagram for public participation in the local government decision-making process.

One of the notable findings of this research is the lack of statistical data related to public participation in Delft. While there are several platforms and channels available for citizens to engage with the local government, there is a lack of concrete data that can be used to evaluate the current state of public participation. This gap in data poses a challenge for policymakers and practitioners in assessing the effectiveness of public participation initiatives and making data-driven decisions. The absence of statistical data also makes it difficult to track changes over time and measure the impact of new initiatives. It is important for the local government to collect and analyze data related to public participation to improve the decision-making process and ensure that citizens' voices are heard.

Overall, the findings suggest that there is a huge need for the municipality to develop more accessible and innovative forms of public participation in order to increase participation among the wider population. Thematic analysis joining the surveys, interviews and literature reviews is presented below.

Codes	Theme
Lack of transparency	Mistrust in government
Lack of accountability	
Unresponsiveness	
Public awareness	Privacy issue
Data collection and usage	
Data security	
Lack of interest	Lack of motivation
Lack of time and access	
Lack of knowledge	
Lack of huge marketing campaigns on the used social media platforms	Poor information sharing
Lack of people's education	
Not clear steps of public participation	
Lack of statistics	

Table 5.1: Thematical Analysis - Combined problems of the current state of public participation

Through the interviews and surveys conducted in the research, it was not only the problems that were discovered in the current state of public participation in Delft. The data collected also provided insights into the needs of both citizens and governments regarding public participation. One of the major needs is the availability of resources for public participation, including online platforms and informational materials. Another crucial need identified is privacy protection, which is a critical concern for citizens while participating in government decision-making processes. Two-way communication between citizens and government is also a key requirement for effective public participation. Furthermore, digitalization is a major concern for citizens, with the increasing demand for more user-friendly and accessible online platforms. The need for transparency in government decision-making was also emphasized during the research, with citizens requesting clear and concise information on government policies, procedures and decisions. Another important need identified is the need for expertise in public participation processes, as well as citizen collaboration in decision-making. Finally, incentives for public participation were also discussed, with citizens requesting more recognition and rewards for their active involvement in government decision-making processes. These needs should be taken into account while developing and implementing strategies to improve public participation in Delft.

Codes	Theme
Easy to reach	Availability
Focus on User Experience	
Available all the time	
More online data	
Confidentiality	Privacy
Data security	
Feedback-driven	Communication
Conversational	
Uniting with other citizen	
Collaboration with others	
Online	Digitalization
Digital	
Automated	
Global Reach	
App	
Transparent voting	Transparency
Seeing results	
Money transparency	
Bring experts	Expertise
Knowledgable people to help with the decisions	
Any benefits for participating	Incentives
Benefits to use within the city	

Table 5.2: Thematical Analysis - Combined needs for the current status of public participation

Last but not least, it has been discovered that if people participate in the decision-making process in the city it is mostly due to the direct influence of the decision on their lifestyle - such as changing the traffic flow on the street that someone is living.

5.3.1. Main Grey Area

After multiple interviews with government officials and surveys with a citizen, several specific points have been made. Usually, the citizens that are directly affected (as one of the key stakeholders) by the decisions are much more eager to participate in public participation. Additionally, several documents and research from the people's involvement confirm that. People care much less about the decisions made outside of their neighbourhood, especially when they do not believe that they might be affected by them (Lupia, 2016). Nevertheless, decisions made within the municipality and especially close proximity, even though they do not have a direct effect, might indirectly influence the lives of the people. Giving a small example, making a decision of shutting down the traffic on the streets nearby or in the city centre, might increase traffic in the parallel streets. Or even shutting down a school in another part of the city affect multiple things in the overall municipality, such as bigger traffic in other schools, less industry involvement towards this area due to smaller incentive for people to buy properties in that region as well as a drop in the property prices.

In every decision, people belonging to the *grey area* could change, as some of the decisions would be more appealing to the people more interested in educational matters, while others to the industrial ones. The main problems in the current public participation methods are lack of reach and understanding, as well as accountability. There are multiple ways of incentivizing the people from this group to participate in the decisions. A solution, that would incentivize people belonging to the grey area for the given decision would eagerly improve the statistics in public participation, as currently, most people are indifferent about any decisions which they believe are not affecting them directly.

In order to understand why the people from the grey area in the specific decision do not participate in

public participation, root cause analysis can be performed (Rooney & Heuvel, 2004).

1. Why people belonging to the grey area do not actively participate in the decision-making process in the city? - They do not feel affected by the decisions in the city, cause they do not reside in close proximity to the place where the problem occurs.
2. Why they do not feel affected by the decisions? - There is a small understanding of the potential effects of the given decision, both short-term as well as long-term on the different regions and neighbourhoods in the city.
3. Why there is a small understanding of the potential effects of the provided decisions? - Both the reach and transparency from the marketing perspective are not high enough to incentivise people to provide their input for other decisions.

Improving both the reach, as well as transparency could tackle this problem and hopefully increase the number of people from the grey area to participate in the decision-making process in the city.

5.3.2. Influencing the grey area

Nowadays, whenever there is a decision usually only the information related to that part is provided by the municipality. In order to sufficiently focus on the needs of the public and additionally focus on increasing transparency, trust and accountability as well as incentivize people and make the whole decision-making process faster and easier for people several changes should be made. People coming from the *grey area* are indifferent about the decisions outside of their neighbourhood not knowing that those decisions might affect them. In order to increase their awareness of the decisions and what is more important - the consequences of those decisions, that information should be provided at the start of any changes made. Providing simple, while also concrete information related to the decision will both increase the transparency from the city, as well as increase the effect of the given decision on the people belonging to the *grey area* group.

In generalizing the problem to the bigger cities and communities, additional points should be reflected. This research is based on the city where approximately 105k people live (Delft, 2023), and where there are not so many decisions made, which makes it relatively easy on sharing that information with the people. It will be quite differently in the metropolises like London or Istanbul where millions of people live (Review, 2023), different approaches towards sharing the information should be used. The amount of information produced and generated by those cities would be too much for people to participate, therefore some filtering and sorting approach to the decisions should be made. People should be aware of the decisions in their district, as well as in others that could potentially influence them the most and should be able to miss the decisions less important from their perspective. By performing such a filtering and sorting approach, there is more input coming from the citizens to the city, while also increasing the quality of the responses, making the people and citizens accountable for their decisions, especially when they are aware of the possible effects of all of their votes.

5.4. Challenges and limitations of widely used public participation methods

The interviews with government officials and the literature review identified several potential challenges and limitations of the current public participation methods. One of the main challenges is the digital divide (Van Dijk, 2017), which refers to unequal access to technology and the Internet. This issue can prevent some citizens from participating in public discussions and decision-making processes, especially those who are less tech-savvy or who do not have access to high-speed internet. As a result, the public participation methods need to be designed in a way that ensures that all citizens have equal access and opportunity to participate.

Another significant challenge is that the current public participation methods can be time-consuming and logistically challenging (Baker et al., 2005). This can lead to a lack of participation, particularly from busy citizens who have limited time to attend meetings or provide feedback. It is important to explore ways to simplify the process and make it more user-friendly to encourage wider participation. When not all the people show up, and mostly old people who have time or highly educated people trying to obtain their specific benefits, the benefits of others are forgotten. What is more, the poor people are not represented very well, especially when they do not have an occasion of sharing their problems.

Cost is also a challenge associated with public participation methods (Louv & Fitzpatrick, 2012). Establishing and maintaining participation mechanisms, such as online forums and public meetings, can be costly, especially for smaller municipalities with limited budgets. This may create barriers to participation and limit the range of available options for engaging citizens.

The complexity of designing and implementing public participation methods is another potential challenge (Vari, 1995). A well-designed public participation method requires careful planning, stakeholder engagement, and expertise. However, municipalities may lack the resources, time, and skills to design effective public participation methods, which can lead to ineffective public participation mechanisms.

The interviews and literature review also identified that the current public participation methods lack transparency and have limited reach to the citizens. Public participation methods need to be designed in a way that ensures transparency and that all citizens are aware of the opportunities available for public participation, as well as of the decisions made in the city and the follow-ups of their discussions. Additionally, two-way communication should be emphasized, enabling citizens to provide feedback and suggestions.

Finally, the lack of incentives for citizens to participate is a challenge. If the public participation methods do not offer sufficient incentives for participation, some citizens may choose not to engage. Thus, there is a need to explore ways to motivate and incentivize citizens to participate actively in the public participation process. The thematic analysis gathering the information from the interviews and the methods found in the literature shows the main combined challenges in the public participation method world.

Codes/Methods	Theme
Online platforms	Digital Divide
Lack of access to technology	
Less effective for older people	
Community Meetings	Time-Consuming
Public hearings	
Require people commuting to the meeting	
Community Meetings	Logistically Challenging
Public hearings	
Require all people having the same time free	
Advisory committees	Expensive
Task forces	
Working groups	
Crowdsourcing	Organization Complexity
Citizen Science	
Lack of transparency	Nontransparent
No automated statistics	
Community meetings	Limited reach
Public hearings	
Nondigital methods	
No additional value for the citizen	Lack of incentives
Lack of bonuses	

Table 5.3: Thematical Analysis - Combined challenges and limitations of the current public participation methods

5.5. Can blockchain tackle those challenges and limitations?

The interviews with blockchain experts and government officials, along with the literature review, revealed several ways in which blockchain and NFT technologies could potentially address the challenges and limitations of the current public participation methods. Firstly, blockchain technology could enable a transparent and secure platform for citizens to participate in decision-making processes (Seltzer & Mahmoudi,

2013). The introduction of decentralized autonomous organizations can provide another way to unite citizens into participating together with the municipality. This would enhance trust between the government and citizens, as all participants would have access to the same information and decisions could be made through a decentralized and consensus-based approach.

Secondly, NFT technologies could provide incentives for citizens to participate in public decision-making processes. By issuing unique tokens to citizens who participate, the government could incentivize engagement and provide a sense of ownership and value to the citizens. This approach could also facilitate the creation of a market for citizen-generated ideas, which could be traded and used to determine the most popular and effective ideas for decision-making processes.

Thirdly, blockchain and NFT technologies could increase the accessibility of the currently available public participation methods. By streamlining the decision-making process through online platforms and the use of blockchain, citizens could easily participate through their smartphones or computers. Additionally, the use of NFT technologies could provide a more user-friendly interface, with elements of gamification for citizens to engage with the government.

However, despite these potential benefits, there are still some challenges and limitations associated with the use of blockchain and NFT technologies in public participation. One such challenge is the digital divide (Van Dijk, 2017), as not all citizens may have access to the necessary technology or be familiar with the technology required to participate. People would have to have electronic devices to participate in society. Additionally, the technical complexities involved in implementing these technologies could create barriers for both citizens and government officials. Creating and implementing such a solution requires significant technical knowledge and infrastructure and requires many resources to prepare the whole solution.

Implementing blockchain technology as a solution to the challenges and limitations of the current public participation methods might be expensive. Blockchain is a relatively new technology, and its development and implementation require specific expertise, which can be costly to acquire. Additionally, blockchain networks need a large number of computers to store and verify transactions, which can add to the cost of setting up and maintaining the network. Moreover, as blockchain technology is still in its infancy, there is a lack of established standards and regulations, which can add to the complexity and cost of implementing the technology.

The findings suggest that blockchain and NFT technologies can potentially address several challenges and limitations in the current public participation methods. These include increasing transparency, simplifying access, enabling a united community, and providing a secure and decentralized platform. However, it should be noted that not all challenges can be solved through blockchain solutions. For instance, the issue of the digital divide may persist, as not all citizens have access to the necessary technology. Additionally, the cost of implementing blockchain solutions may be a limiting factor for some municipalities. Therefore, while blockchain and NFT technologies hold promise for enhancing public participation, it is important to approach their implementation with a realistic understanding of their capabilities and limitations.

Solved out of the box	**Solvable yet require resources**	**Not solvable**
Time Consuming for citizen	Lack of incentives (require additional platform utilizing NFTs)	Digital Divide
Logistically challenging for government	Organization Complexity (on the start)	Expensive
Nontransparent		
Limited reach		

Table 5.4: Thematical Analysis - Combined tackled challenges and limitations of the current public participation methods

5.6. Blockchain implementation challenges

The implementation of blockchain and NFT technologies in public participation poses several challenges for cities. One of the main challenges is the cost and technical expertise required to develop and deploy such solutions (Sedlmeir, Buhl, Fridgen, & Keller, 2020). These technologies require significant investments in hardware, software, and specialized personnel. Moreover, blockchain and NFT technologies are complex and require a high level of technical expertise to operate effectively, which is not always available within the government or city administration. Additionally, there may be legal and regulatory challenges that need to be addressed, such as data privacy and security concerns, as well as ensuring compliance with local laws and regulations.

Another challenge is the potential digital divide between citizens who have access to technology and those who do not. This can result in some citizens being excluded from participating in the decision-making process, which undermines the democratic principles of public participation. Furthermore, ensuring the accuracy and reliability of the data collected through blockchain and NFT technologies can be challenging, as they rely on a decentralized network of nodes that require consensus.

Moreover, the adoption of blockchain and NFT technologies in public participation requires the buy-in and cooperation of all stakeholders involved. Resistance to change and lack of awareness of the benefits of these technologies may hinder their adoption. Finally, the scalability of blockchain and NFT technologies is also a challenge, as they may not be able to handle large volumes of data and transactions.

In summary, the implementation of blockchain and NFT technologies in public participation is a complex process that requires significant investments, technical expertise, and regulatory compliance. The potential digital divide, stakeholder buy-in, and scalability issues are additional challenges that need to be addressed. Addressing these challenges will require close collaboration between government, citizens, and technology experts to ensure that these technologies can be effectively implemented and utilized to enhance public participation in decision-making processes.

Codes/Topics	Theme
Expensive	Cost & Resources
Cost	
Technical expertise	
Environmental problems	
Legal requirements	Privacy & Legislations
Policy	
Privacy	
Security Concerns	
Compliance with already existing laws	
Government surveillance	
Cooperation of all stakeholders	Stakeholder engagement
Multi-actor decision making	

Table 5.5: Thematic Analysis - Implementation challenges

5.7. Additional blockchain limitations

The above implementation challenges assume that the technology is already available and it is possible to utilize it as it is to implement a production-ready platform for public participation. However, the reality is much different than expected. As mentioned previously in the data collection methods, as well as the literature review, there is still a lack of research on multiple blockchain topics. Both the interviewees, as well as the articles found on the internet, confirm one sentence - blockchain is not yet ready to be adapted to the city. Multiple problems and challenges have to be tackled, some Pilot programs have to be run, as well as additional research has to be performed to make sure, that the platform would be sufficient for both the citizens as well as policymakers. First of all, the research provides information about the problems related to the organizational processes and holding the majority of the network, legal regulations as well as

privacy and security. Interviewees have mentioned multiple times about the first one, making it the hardest to analyze thoroughly and tackle. What is more, the literature review also suggests other problems such as environmental ones. Blockchain uses an enormous amount of energy, i.e. only Bitcoin miners use more energy than the entire Argentina (Brown, 2022)! Different consensus mechanisms would have to be analyzed, making it more energy-efficient to mine. Last but not least, there were found several technical issues. Scalability with limitations of transactions per second, as well as the intuitive user experience that would have to sufficiently provide all the information to multiple age groups. In order for blockchain technology to be thoroughly available, all of those problems should be tackled and only afterwards (if none of the new ones will be found), the community and government could start implementing some pilot projects.

5.8. Is there a potential for blockchain technology?

Even though the new emerging technologies especially blockchain could influence and help with those problems and could be used as a way to influence the citizens, especially from the grey area, there are multiple problems coming in between. The research has realized, that in order to utilize blockchain technology towards public participation, multiple additional steps and research would have to be performed.

First of all, the technology is not ready yet to be adapted, as multiple other problems would have to be tackled and thoroughly analysed to start developing the platform based on blockchain technology. All of the problems, challenges and limitations found in the research are going to be explained here, giving the main pain points, to make future research easier.

From the multiple interviews, as well as getting more understanding of the needs of the citizens and end users, several main pain points have been created. First of all, in order for the application to be completely safe from the tampering and manipulating perspective, none of the parties should obtain 51% of the network power (Ye et al., 2018). It creates multiple problems from the infrastructure and organizational side, how the network should be composed, who should be able to become the nodes in the computer, as well as making sure that none of the external parties (such as enemy governments) would be able to join the network and start spreading the fake news or creating the chaos in the given region. In order to utilize the blockchain platform solution in the future, research about this topic is necessary to fully evaluate the potential attack factors and mitigate anyways for tampering.

Secondly, another main problem that was discovered is the legal regulations in the context of the decisions made on the platform. In order for the potential platform to be viable and accountable, all the decisions that are confirmed in a digital world have to have an effect on the real one. In order to do it, there should be a party or a group of people that would make sure, that those decisions have their follow-ups and that the digital votes have a meaning in the context of real ones. Such an approach would require multiple legal regulations to be changed, as well as multiple public representatives to adapt to the new approach to public participation.

Thirdly, privacy and security are enormous problems. On the one hand, it would be necessary to make sure that people do not share the data that they object to, as well as only the citizens can access the platform. In order to fully protect citizens from any social engineering attacks and make sure that their decisions are not revealed to others multiple safety and security measures have to be taken into account, which might create a huge resource need for the security research. Proper analysis of the potential solution would have to provide both top-level encryption standards, as well as data masking processes and identity verification protocols, which would have to be employed to make sure that there are no imposters in the network as well as only citizens have access to the platform.

Apart from the political and societal issues, there are also technical and environmental. Starting with the technical issues, scalability on the blockchain might create a burden when bigger cities or even countries would try to implement the generalized solution. Currently, depending on the blockchain network and its size, there are limits on the number of transactions performed - for instance, 7 on the Bitcoin (Monrat, Schelén, & Andersson, 2019). When there are millions of people living in the city, when even a small percentage of people participate in making the decision, there might be even hundreds of thousands of transactions per second. Researching the appropriate blockchain network and chain would be necessary to utilize the most cost-efficient solution for the given needs and possibly even broader generalization in the future.

What is more, for the platform to be globally and nationally available, it should be appealing to all the people in the community, including students, young professionals as well as the older part of the society. However, blockchain, with all of its features and possibilities might be really hard for people to understand, especially the ones that do not use the technology very often. Multiple terms, such as encryption, cryptography, network, wallets, NFTs and nodes might be really hard to understand and work with it. Therefore, there should be a huge focus from the city to utilise an engaging user interface that would be both engaging as well as intuitive for citizens of all ages. Having applications working on different devices such as tablets and phones might also make it easier for people, who most of their time spent in public transport and have immediate and easier access to the decision-making process.

Last, but not least, there are some environmental issues. Having a safe, secure and scalable blockchain network would require multiple computers and servers storing enormous amounts of data, being constantly connected to the internet and powered up with energy. Research and calculations on the potential costs as well as environmental effects should be made beforehand to understand the effects of utilizing blockchain solution and using it in daily life. It is important to understand the effects not only on the closer proximity but on a national level too and evaluate its energy consumption levels, to make sure that we could supply the necessary energy with green sources and be compliant with the recent European Union Regulations (Commission, 2018).

To conclude, it is not possible to utilize and reap the benefits of the blockchain platform currently. More and more research is necessary to understand, evaluate and hopefully tackle presented challenges and make sure that it will bring more advantages than disadvantages. What is more, more multi-actor decision making and negotiated process approach has to be utilised to engage all stakeholders within the process of improving public participation. The problem of using the blockchain for public participation and improving the current state of it is very complex. Underlying complexity of the problem can be tackled by broadening the agenda and inviting multiple stakeholders to name different issues. What is more, it is necessary to understand the pains of all the stakeholders and evaluate it in the context of adapting this solution. Future researchers should take care of further evaluation of the specific action points that this research has found and focus on trying to solve them specifically. Nevertheless, the solution can solve multiple issues, which exist in a more digitalized society like the case of an Active Citizen (Holder, 2017). Evaluating such a solution and slowly integrating it into society, might benefit us in the future, bringing both the cities and citizens closer to each other.

6

Conclusion

6.1. Closing Remarks

In conclusion, this study has shed light on the potential of blockchain technology in transforming public participation in cities. The findings have highlighted the benefits of blockchain, such as increased transparency, trust, and efficiency in decision-making processes, as well as enhanced citizen engagement and empowerment. However, it is important to acknowledge that the adoption of blockchain in public participation is currently impossible and holds multiple challenges that have to be overcome in order to provide a reliable and production-ready working solution. Issues related to society, technology and the environment need to still be addressed for successful implementation. In order to tackle those multiple issues, multi-actor decision-making, involving all the stakeholders and collaboration between them is necessary to provide comprehensive research and available solution. Furthermore, the ethical implications and potential risks associated with blockchain technology should be carefully considered and mitigated. Despite these challenges, the promising results and insights from this research provide a solid foundation for future exploration and experimentation in harnessing the power of blockchain for inclusive and participatory e-governance. By addressing the identified research gaps and collaborating across disciplines, academia, industry, and government can work together to unlock the full potential of blockchain technology in shaping the fully democratic future of public participation.

6.2. Research Questions

The research questions posed in Chapter 1 are repeated below for convenience.

Sub-Research Question 1

What is the current state of public participation in the local government decision-making process?

This study has provided a comprehensive understanding of the current state of public participation in the local government decision-making process in Delft. The research findings have shed light on the existing methods and practices employed by the local government to engage citizens and involve them in decision-making. The analysis has revealed both strengths and limitations in the current public participation initiatives, highlighting areas for improvement and potential opportunities for innovation, while also giving an idea of the evaluation process for new researchers, trying to verify the state of public participation in different municipalities. Moving forward, it is crucial for policymakers and stakeholders to reflect on these findings and consider implementing strategies that enhance the effectiveness, inclusivity, and transparency of public participation in Delft. By leveraging the insights gained from this research, local authorities can develop tailored approaches that better align with the needs and expectations of the community, ultimately fostering a stronger sense of citizen ownership and contributing to the overall well-being and development of the city.

Sub-Research Question 2

What are the potential challenges and limitations of the current public participation methods?

This study has also dived into the potential challenges and limitations of the current public participation methods employed not only in the context of Delft but also in the national and global context. Through an extensive examination of the literature, interviews, and surveys, various factors hindering the effectiveness of public participation have been identified. These challenges include issues related to accessibility, inclusivity, transparency, and trust. The findings highlight the importance of addressing these limitations to ensure meaningful and impactful citizen engagement in decision-making processes. It is crucial for policymakers and other stakeholders to recognize these challenges and work towards implementing strategies that overcome barriers and promote more effective public participation. By doing so, the local government can foster an environment that encourages broad and diverse citizen involvement, ultimately leading to more informed and democratic decision-making outcomes.

Sub-Research Question 3

To what extent can blockchain and NFT technologies tackle the challenges and limitations existing in the current public participation methods?

Apart from that, the study also explored the potential of utilising emerging technologies like blockchain and NFT technologies in addressing presented challenges and limitations. Through a comprehensive analysis of the literature, interviews, and surveys, it has been revealed that on the one hand, these emerging technologies could offer a promising solution in the future to enhance citizen engagement, transparency, and trust in the decision-making process. On the other hand, such a solution is currently not implementable, due to the lack of knowledge and research about the specific use cases and multiple implementation challenges that hinder the adoption of these technologies. Even though these technologies have the potential to overcome limitations such as lack of trust, inclusivity, and efficiency, the adoption and implementation of blockchain and NFT technologies in public participation are still in the early stages, and further research and practical applications are needed. It is crucial to consider multiple factors, technical considerations, environmental aspects and potential ethical implications associated with the use of these technologies. By continuing to explore and evaluate their effectiveness, policymakers and stakeholders can make more informed decisions on whether to leverage blockchain and NFT technologies to create more transparent, inclusive, and participatory public decision-making processes.

Sub-Research Question 4

What would be the implementation challenges of using the blockchain and NFT approach in public participation in cities?

The findings related to implementation limitations associated with using the blockchain and NFT reveals several key challenges that need to be addressed for successful implementation. Firstly there are societal challenges, such as infrastructure and operational challenges, legal regulations and privacy and security. These issues must be carefully addressed to ensure a robust and reliable infrastructure for public participation and clear guidelines and frameworks should be developed to navigate these legal complexities. Secondly, there are technological challenges, such as scalability issues and user-experience ones. These challenges require an excellent team of engineers to develop the solution with the best quality as well as researchers, trying to find the most scalable way for utilizing blockchain technology in public participation. Last but not least there are environmental limitations, which need to be also researched and evaluated to provide a clear understanding of the potential effects on the environment. Overcoming these implementation challenges will require a comprehensive approach that involves collaboration between governments, technology experts, e-governance experts, citizens, and other relevant stakeholders. By addressing all of these challenges, cities can start harnessing the potential of blockchain and NFT technologies to create more transparent, efficient, and participatory public participation processes.

Main Research Question

What is the added value of an innovative blockchain and NFT approach on public participation in the local government decision-making process?

Last but not least, the main research has explored the added value of an innovative blockchain and NFT approach on public participation in the local government decision-making process. The findings demonstrate that the adoption of blockchain and NFT technologies can bring numerous benefits to public participation. Firstly, these technologies enhance transparency by providing a decentralized and immutable record of information and transactions, thus increasing trust and accountability. Secondly, blockchain and NFTs enable secure and efficient data management, ensuring the integrity and privacy of participants' information. Thirdly, the use of smart contracts and tokenization incentivizes citizen engagement and fosters a sense of ownership in the decision-making process. However, it is important to acknowledge the challenges and limitations discussed in this study, including societal considerations, technical and environmental complexities. Addressing these challenges is necessary for the successful implementation of blockchain and NFT technologies in public participation. Overall, this research highlights the significant potential of blockchain and NFTs in transforming and improving public participation, yet further research is necessary to implement the solution in the cities.

6.3. Academic Contributions

The results of this research contribute to the academic understanding of the intersection between blockchain and NFT technology and public participation. The findings show the potential benefits and limitations of utilizing blockchain in enhancing citizen engagement and decision-making processes. From an academic perspective, the research expands the existing knowledge base by exploring the experiences and perspectives of key stakeholders, including government officials, citizens, and blockchain experts. The analysis provides valuable insights into the practical implementation of blockchain technology, highlighting the main challenges which hinder the possible adoption of the solution. These results contribute to the broader discourse on e-governance, public participation, and technological innovation by providing empirical evidence and in-depth analysis. What is more, the research shows the necessity of the appropriate multi-actor decision making approach for such a huge problem. Understanding and evaluating the needs of multiple stakeholder groups and ensuring that all the pains are taken into account to tackle the problem of the public participation. The study also provides a clear path, for the future research and tries to drive the implementation process of the blockchain based public participation platform towards the real life scenario. The academic community can draw upon these findings to further explore and refine the analysis and build up new knowledge solving discovered challenges to make the blockchain solution available in the future. What is more, the theoretical knowledge and research performed in the study can be verified and extended by evaluating other municipalities in the Netherlands, as well as in Europe - which can help in building a unified solution and approach for the entire European Union.

6.4. Practical Implications for Policymakers

The practical implications of the research findings have significant implications for policymakers and government officials involved in public participation processes. The results not only highlight the potential of blockchain technology to enhance transparency, accountability, and citizen engagement in decision-making but also provides multiple limitations in currently existing methods, as well as discuss different approaches to tackling those limitations. Even though the blockchain solution, still has a way to go and cannot be yet adopted, providing a secure and decentralized platform, can facilitate efficient and trustworthy information exchange between the government and citizens, fostering greater trust and participation in the policymaking process. Trying to find a similar solution, based on another emerging technology or utilising similar approaches in the currently available methods may be a cheaper approach for a faster and more significant increase in participation in the decision-making processes. The findings also emphasize the importance of creating user-friendly interfaces and ensuring accessibility to maximize the engagement of citizens. Policymakers can utilize these results to inform the development of strategies and policies that leverage other technologies to improve public participation initiatives. By incorporating the practical insights gained from this research, policymakers can foster an environment that encourages innovation,

collaboration, and active citizen participation, ultimately leading to more inclusive and effective decision-making processes. Last but not least, policymakers can already start making research, talking to consultants and experts in different technology to further understand the possibilities and tackle the limitations of their currently used methods.

6.5. Practical Implications for Blockchain Experts and E-Governance researchers

The practical implications of the research findings also hold significant value for blockchain experts and researchers in the field of e-governance. First of all, the research provides more information on the potential of blockchain technology in enhancing public participation and governance processes. The findings provide valuable insights into the challenges and opportunities associated with implementing blockchain solutions in real-world contexts. Blockchain experts can leverage these results to further refine and improve existing blockchain systems, addressing the identified limitations and maximizing the benefits for public participation. What is more, the e-governance specialists can evaluate the research and take the main findings into consideration while shaping the future of the e-governance world. The research also highlights the importance of intra organizational collaboration between blockchain experts, policymakers, and other stakeholders to ensure the successful implementation of blockchain technology in public participation initiatives. The research provides different ideas that could be utilizes for improving the business processes not only for the municipality and the policymakers, but also within the industry. By incorporating the practical recommendations and lessons learned from this research, blockchain experts can contribute to the development of innovative and effective blockchain-based solutions that empower citizens and foster more transparent and inclusive decision-making processes.

6.6. Industry implications

Provided research has also multiple industry implications. From the context of the companies, if the proposed project for voting were accepted that would increase the adoption of the blockchain technology within multiple sectors. It would ensure the similar levels of security and transparency, gaining all the potential benefits from the blockchain technology. What is more, the proposed voting and platform approach can be utilised in the different organisations. Engaging stakeholders, immutable and transparent record keeping and enhanced security are important benefits of adopting this solution in the organisations. It can improve many different voting processes that already exist in different companies, such as ones made during shareholders meetings and board of directors meetings. It is important to mention, that in big publicly traded companies some of those meetings might have enormous number of people and usage of the appropriate voting procedures is important, especially within the context of transparency and accountability. Blockchain solution prepared for the policymakers, would have to be slightly adjusted (such as the different voting power considerations) to be adopted also by those companies.

What is more, managers within the company could also try to use parts of this research within their teams, especially for the incentivization ideas. More and more different companies try to use the gamification solutions to motivate their workers. Using the blockchain based solution can provide additional incentives, especially as people's obtaining the benefits can be quickly recognised publicly throughout the company and on a bigger scale. What is more, providing a way to exchange those NFT's for different perks and coupons might be an engaging way for managers to increase their teams motivation.

6.7. What can future research explore based on this research?

In light of the findings and insights gained from this study, several areas for future research can be identified to further advance the understanding of blockchain technology in public participation. The complexities and nuances associated with blockchain implementation, governance structures, and scalability require deeper investigation and empirical testing. Additionally, the social, economic, and legal implications of integrating blockchain into existing systems need to be thoroughly examined to ensure responsible and sustainable deployment. Further research should also focus on exploring the long-term effects, addressing potential security and privacy concerns, and developing robust frameworks for regulation and standardization. Apart from those limitations, there are multiple research that can be built following this one. First of all, similar analyses performed in different countries and cities could help in evaluating the problems and

needs of citizens in multiple regions. Having an understanding on the global scale could help in creating a unified solution between the societies, making sure that with the new solution, everyone could easily and democratically participate in the decision-making process in the city. Furthermore, more research is needed on the ethical considerations and implications of blockchain technology in public participation, such as data privacy and ownership. Having a better understanding of the data and its consideration can protect us from violating both European (GDPR) and Worldwide policies about the data privacy context (Wolford, 2018).

Collaborative efforts between academia, industry, and policymakers will be essential in advancing our understanding of blockchain technology and its optimal integration into the management of public participation. By continuing to invest in research and knowledge generation, the way for informed decision-making can be paved and the responsible adoption of blockchain technology in the future. Overall, these future research directions can contribute to the advancement of knowledge and inform the development of effective strategies for leveraging not only blockchain technology but improving already used public participation methods to further enhance and increase the number of people participating in the decision-making process on a daily basis. Personal reflections against the key findings have been presented in the section 6.8, which can be a good starting point for the future research. New research could take one of the ideas provided there and verify it against the real life scenarios or even start a pilot program, analysing multiple of the ideas at once.

6.8. Suggestions to address Limitations

In the performed research there are several limitations which have to be directly stated and explained with several pieces of advice for future researches to use in order to improve their analysis.

One potential limitation related to the **size and distribution of the sample** in this study is that it consists primarily of individuals between the ages of 18 and 30, who are mostly students or young professionals. While this age group is important in understanding the perspectives and preferences of young adults in public participation, it is essential to recognize that public participation encompasses a diverse range of age groups. This narrow age range and specific demographic profile may limit the generalizability of the findings to a broader population (Ferguson, 2004). In the future investigation, it would be much more useful if most of the participants were split between the ages, starting even from people aged before 18 and going even up to 65 years of age, depending on the resources of the researcher. By incorporating a broader age demographic, researchers can gain a comprehensive understanding of how different generations perceive and engage in public participation. This expanded scope would provide valuable insights into the needs, challenges, and preferences of various age groups, ultimately enabling more inclusive and effective public participation initiatives using new technologies.

Secondly, interviews involve **self-report measures**, which can be influenced by participants' subjective perceptions, recall biases, or social desirability bias, potentially affecting the accuracy and objectivity of the data collected (Raphael, 1987) (Grimm, 2010). What is more, the thematic analysis which offers a systematic approach to identifying patterns, themes, and meanings within qualitative data, also has some limitations and problems. The process of coding and categorizing the data into themes is subjective and influenced by the researcher's interpretations and biases. Different researchers may approach the same data differently, leading to variations in the identified themes. Additionally, the thematic analysis relies on the researcher's expertise and prior knowledge, which may introduce confirmation bias or preconceived notions that could influence the selection and interpretation of themes (Oswald & Grosjean, 2004). In order to mitigate this limitation, it would be useful to have a group of researchers collaborating and sharing their views and opinions on the gathered data. What is more, the usage of Artificial Intelligence technology and its tools could be of great benefit to confirm the suspicions related to assigning the given code and theme to the data. Such a solution would decrease the subjective part of the study and reduce the effect of multiple biases.

Thirdly, the study's geographical location and political differences between the countries may introduce **context-specific factors** that could affect the applicability of the findings to other regions or countries with different cultural, political, or economic contexts. Other countries might use different approaches to public participation and experience different problems. Their current status and capabilities might be different, however, the research result could be adjusted to include those differences. In order to mitigate this limitation, future researchers should take into account geographically spread study, analyzing the

approaches of cities at least within the country and combining them together. Providing a generalized and applicable solution for multiple cities should be a priority with several points and considerations that could affect parts of the implementations.

Last but not least, there were **time and resource constraints** within the research. With limited time for the data collection process, several choices related to the scope of the study, number of interviews and surveyed people had to be specified, which might have influenced the results. Despite the potential influence of these limitations on the final outcomes, the researcher conscientiously endeavoured to mitigate such biases and maximize the quality of the research conducted. In future research, it would be useful to provide a longitudinal study, to analyze any potential effects and changes on the given factors within public participation. Increasing the number of respondents will also increase the scientific significance and help provide the most scientific-based results.

As mentioned above, some of the limitations affect the **generalizability** of the research. On the one hand, it is important to mention that both the sample and the resource constraints, as well as context-specific factors have also the influence towards the research. On the other hand, the research and main findings, such as the problems with the public participation should be similar across the different cities using the similar approaches towards the public participation. Main ideas and possible improvements can differ throughout the different cultures and approaches, however the usage of blockchain technology can be utilised in all the places that the blockchain is not banned and it is possible to adapt the regulations for the technology needs assuming that the technological literacy level is similar as in the Netherlands. It is important for the future studies to perform the new research in the cross-city and cross-country random sample to verify and analyse different needs of people and evaluate whether one platform can become a one-size-fits-all solution.

It is advised, that future researchers will take into account all of those points and based on the results from this study will make blockchain technology a new way of public participation in the future.

6.9. Reflection on the key findings

Throughout the research, multiple problems have been found that hinder the possibility of currently using the blockchain and NFT technology as a tool for starting the decision making process. Several those problems, such as rising digital divide, network distribution or even legal problems related to enforcing the digital decisions have been identified and analysed towards the potential solutions. Future research, should build up upon those reflections, evaluate proposed ideas and try to implement them, reducing the gap between the current public participation platforms and high-tech blockchain based decision making processes.

6.9.1. Tackling rising digital divide

Digital divide is the problem related to the gap between the people that have both the skills and access to the digital technology and those who do not (Cullen, 2001). It might be created from the lack of capital or lack of support within the pursue to understand more about this problem. On the one hand, with the currently used methods, cities do not face the problem of digital divide, which might be created by the transitioning towards the E-Governance or even further towards the blockchain technology. On the other hand, those methods require a lot of time and energy from people to participate and also have other problems, 2 of which are mentioned as follows: *time divide* and *limited reach*.

Time divide could be considered as a gap between the people having time and energy to spend their free time voluntarily on participating in the decision making process in the city. With all the offline methods used, many people do not believe in the power of their vote and just decide not to participate in the decision making process. Especially, when they would have to spent their free time, which could be devoted towards their friends or family. What is more, without any new technology, the only way to inform people about any voting or even gathering is through the mail to every citizen, or by trying to create the advertisement in the newspaper. On the other hand, there are still multiple citizen that do not check their mailboxes, and sending hundreds thousands of mails (even in the smaller city) will be enormously expensive and environmentally unfriendly.

New technologies apart of tackling multiple other issues, can tackle both of the issues mentioned above and additionally creates probably some more. On the other hand, with the usage of internet, social media

applications and blockchain, new platforms can make the public participation seamless and integrated within the normal daily schedule of the citizen, giving them possibility to get connected and provide their suggestions during their breaks and whenever they are willing to spend time on it. What is more, they can be on vacation and still provide useful feedback towards any of the existing decisions that the city is working on. Those technologies can provide an important tool increasing the possibility for citizens to be a part of the bigger society.

However, they also require citizens to understand the technology and have appropriate knowledge about using the smartphone, logging to the mail account and usage of the internet and web browser. What is more, not all of the people have the access to those technologies for instance due to the money issues. In order to tackle this problem there has to be several components of the problem analysed. Starting with the identifying of the potential target group that will be affected by the change towards the new solution. Seeing that current youth, as well as people in the mid-forties are already familiarized with the technology, the people that should be target within the context of lack of skill should be older people. Those people, depending on the city and the culture differences, are more familiarized with the newspaper and mail solution for notifying citizens about any upcoming changes. There might be several solutions towards this problem. Firstly, the city could start transitioning towards the usage of new technologies. For all the citizens below certain age, all direct information will be shared throughout the digital technologies, as well as they will be able to see everything on the website. For the older citizen, to still incorporate them within the decision making process and do not exclude them from the vote, it might be wise to still support the older ways of sharing information. Having a targeted approach will allow the municipality to take care of the wide range of people, making sure that no one is forgotten. What is more, providing people with the choice can bring a lot of possibilities. Some of the people might not have any digital devices in their homes and would prefer the paper approach - which is also the same solution as the one presented above.

Last but not least, having the platform working on the blockchain technology might increase this digital divide even more, scaring people from its usage. On the one hand, multiple new benefits and possibilities that this platform will introduce are crucial for the development of the society. On the other hand, those new introductions might be too big and even further scare the people away from using such advanced technology. This is why, the user experience and user interface is crucial within entire project. Providing seamless and intuitive interaction with users and even adjusting the interface depending on the age of the citizen could provide enormous benefits. It might reduce another digital divide that might be created from the blockchain platform and enforce good practices towards the accessibility of the future digital solutions that municipality will use. However further research in context of the potential improvements which might be gained by following those ideas has to be performed.

6.9.2. Blockchain Network distribution

As mentioned in the findings, another limitations preventing from implementing the blockchain technology to the cities is the network distribution within the blockchain network. If the municipality or any of the parties were to obtain the majority of the network the platform will be vulnerable for the 51% attack (Ye et al., 2018). In such a situation the stakeholders who own more than 51% of the network, would be able to tamper the votes and transactions on the network, making it vulnerable for possible manipulation. It is important that none of the parties will obtain such a possibility, allowing them obtaining unfair advantage in the decision making process.

In order to have the safe network distribution within the cities, it is almost impossible to find one-for-all way to make sure that no one would obtain the majority. There might be multiple corner cases, which will be hard to find, and when they are found it will be already too late to fix it. Therefore, in order to safely analyse the network distribution, it might be useful to use and benefit from different multiple strategies.

First of all, as mentioned above, the city should allow the citizens to be participants of the network. By allowing individuals to actively participate in the network, the power of decision-making and consensus is distributed among a larger and more diverse group. This approach helps mitigate the risk of a single entity gaining majority control over the network, as it would require a substantial number of citizens to collude. Furthermore, this inclusive model promotes decentralization, transparency, and accountability, strengthening the overall security and integrity of the blockchain system. Through citizen participation, cities can foster a sense of ownership and engagement, while bolstering the resilience and effectiveness of their blockchain infrastructure.

Secondly, the city should allow organizations and companies working in the cities to also participate in the network. Diverse range of stakeholders will be involved in the decision-making process, reducing the risk of a single party gaining majority control. This approach promotes a balanced distribution of power, as both citizens and organizations play a crucial role in maintaining the network's security and integrity. Involving organizations and companies not only strengthens the network's resilience but also ensures that the interests and expertise of various sectors are represented. This collaborative model fosters a sense of shared responsibility and collective governance, fortifying the city's blockchain infrastructure against potential attacks while encouraging economic growth and innovation.

Thirdly, apart of the three main stakeholders participating in the decision making process being: citizens, municipality and companies and organizations working in the city there should be two more participants added to the blockchain network: EU and national level politics to make sure that the validity and democracy is not hindered. By allowing these higher-level entities to have oversight and involvement, an additional layer of scrutiny and accountability is introduced. Their participation helps to ensure that the network operates in accordance with broader regulatory frameworks and aligns with national and EU-level policies. Moreover, their involvement brings in expertise and resources that can further strengthen the security and integrity of the blockchain system. By fostering collaboration between cities, national governments, and the EU, a cohesive approach to combating 51% attacks can be developed, enhancing the overall resilience and effectiveness of blockchain infrastructure. This inclusive model not only provides increased trust and confidence in the network but also reinforces the alignment between local, national, and supranational levels of governance.

Fourth, in order to make sure that none of the parties will threaten the democracy of the platform, it is essential to establish a maximal limit for the parties' participation and influence in the blockchain network. By implementing such a limit, the concentration of power within the network is curtailed, preventing any single entity, be it citizens, organizations, or companies, from obtaining excessive control. This ensures a fair and balanced distribution of decision-making authority, minimizing the possibility of collusion or malicious activities. Setting a cap on participation also promotes diversity, inclusivity, and competition within the network, encouraging a healthy ecosystem of stakeholders. By placing a clear limit, cities can safeguard the decentralization, security, and integrity of their blockchain infrastructure, creating a more resilient and trustworthy environment for all participants involved. Proposed limits are presented in the table below:

Stakeholder Group	Limit
Citizens	20%
Companies	20%
Municipality	20%
Country	20%
EU	20%

Table 6.1: Proposed limits for network distribution

The main reason for those proposed limits is that it ensures that none of the group can by themselves obtain the majority of the network. In order for the manipulation to happen, at least 3 of the groups would have to cooperate together. This is the main reason that the EU was added as a safeguard, ensuring that even if the country, together with municipality decides to tamper the results, it would not be able to push the results, because of the lack of the third party that would agree with those manipulation. Having those safeguards is a reasonable way to handle the problems.

Nevertheless, it is still important to evaluate all of those approaches together and combine them as one. Only by combining benefits of multiple strategies it is possible to prevent the manipulation and ensure safe and democratic way of decision-making processes. The future research should evaluate those strategies and provide some real life examples of implementation, with the potential improvements and changes in the stakeholder groups or the limitation parameters ensuring fair and safe network distribution.

6.9.3. Enforcing digital proposals to the offline world

As the online platform especially in voting, the implementation of the proposal made by the citizens would have to be investigated. Assuming that there already exists a platform, which all of the citizens have the possibility to use and there is no possibility of tampering its results, the decision enforcement would have to be analysed. First of all, questions like:

1. Who can suggest/create a proposal in the city? Is it all stakeholder groups or only specific ones?
2. Who can vote on the proposal on the city? Should i.e. EU have the possibility of being a participant and vote for or against the proposals?
3. When does the proposal is approved? Does it require 51% of all the citizens in the city, including the entities from the organization or less? Does any of the specific groups have more voting power than the other (such as votes from municipality count as 2 and votes from the citizens count as 1)?
4. If the proposal is approved, how can it be effectively enforced and implemented in the offline world? Who would be responsible for that?
5. How can we ensure that the offline implementation of digital proposals is transparent, fair, and accountable?
6. If there is a final decision that has been approved and it requires suppliers/companies to perform some additional work (such as extending the street), should the applications for those decisions be also available on blockchain and transparent to the public? How to enforce that the given company is a reliable entity can sufficiently provide the job without sharing its details to everyone?

During this research, multiple findings against those questions have been also analysed. Future researchers are encouraged to build upon this knowledge and add more questions or validate the proposed solutions for the possible usage of this technology.

Firstly, starting with who should be able to propose the new idea in the city - all of the groups citizens, companies and municipality should be able to do it, including their reasoning towards the proposal. New national and supranational regulations should also be provided to the platform, so the city and its citizens can make a decision on how to be complaint with them. In context of the city-level decisions, country shouldn't be able to provide the decision in the city that is targeted towards it. Country-wide politics do not have resources and capabilities to analyse and understand the needs and the possibilities of the given city within its borders. Nevertheless, country should still be able to create and implement the programs, which are mandatory for the cities - i.e. national wide railway, which requires train stations build in every city. Such a regulation could be presented in the blockchain platform of the city decisions as approved (of course assuming that it was already accepted on the national level politics), and afterwards the follow-up such as where to build the station, who should be responsible for it should be decided within the city decisions with cooperation of the country, by utilising both inter-intra approach of decision making.

Secondly, the evaluation of the stakeholders group having voting rights within the decisions should also be analysed. Within the one city, the stakeholder groups that have the power are citizens, companies (through the representatives) and municipality. Both the country level politics, as well as the EU should not be able to vote for the specific lower-level decisions for similar reasons as presented above. Evaluation of all of the small decisions (such as restructuring of the public building) is too big to evaluate on the bigger level, therefore it has to be separated. However, it is important to verify the proposed solutions, and make sure that they are complaint with the current regulations. Utilising new technologies like Artificial Intelligence, Big Data and Cloud Computing could help in finding the appropriate regulations and articles which might be related to the proposed decision. Mentioning all of those information on the decision proposal can provide much more data for people that are interested, making sure that everyone is satisfied and knowledgeable about the potential outcome.

Thirdly, to answer how many people or entities (such as from companies) are necessary to approve a proposal and how does the voting power look like, multiple other considerations has to be taken into account. Additional question like:

- Should it matter depending on the proposal modification type (i.e. creating, restructuring, destroying, modifying)?
- Should the proposal scale (i.e. single city streets, multiple city streets) have an influence?

- Should the proposal type (i.e. infrastructure, environment, regulation, public service) have an influence?
- Should the stakeholder impact (i.e. increasing power of one group within the city and decreasing other) have an influence?
- Should the budget considerations be taken into account (how much budget is left and how much does the given proposal's estimation cost)?

Striking a balance between inclusivity and practicality is crucial. Too high threshold may limit participation and hinder decision-making, while too low threshold may risk excluding important perspectives and implement the decisions that should be considered differently. Overall, there should be a minimal number of votes for the given decision to be even considered further. It should depend on the size of the city, for instance 100 000 of the citizens require at least 10 000 citizens participating, from which at least 50% have approved this decision. In case of not enough people being active on the platform other ideas such as getting the appropriate percentage from the daily active users on the platform can be taken to evaluate whether those ideas are considered as valid, or maybe they should be modified or completely rejected. From the context of participating people, all the groups that can vote, should achieve at least 50% of its votes to approve the decision. Utilising this approach across the groups ensures that it will benefit most of the people and organisations. It should be up to the given stakeholders, and especially people that created such a proposal to further advertise and convince other people, companies and municipality members about their idea.

The idea presented in this paragraph provides the simple and generally optimal approach to satisfy the majority. On the other hand, further research on the possible influence of the parameters and providing more unique approach towards the given proposals might bring more benefits and be a more appropriate threshold towards some situations. However in order to do it, performing some survey analysis together with interviews might reveal important points that have not been considered earlier.

When the idea is approved and is ready to be implemented, there has to be not only sufficient laws and regulations towards it, but also a group of people that would be responsible for the implementation, from the start till the end. Firstly, the city government should play a vital role in overseeing the implementation process, however in order to make sure that the decision is followed as agreed upon, transparency of any possible follow ups is required. They will be responsible for translating the digital proposal into actionable plans, allocating resources, and coordinating various agencies and entities involved. Additionally, regulatory bodies may be involved in ensuring compliance with applicable laws and regulations. Collaboration with external entities, such as contractors, service providers, or technology partners, may also be necessary to facilitate the implementation. Moreover, community engagement and participation are crucial in ensuring the decision aligns with the needs and aspirations of the residents. Therefore, it is essential to be transparent from the scratch and involve community organizations, local stakeholders, and citizens in the implementation process to foster ownership and garner support. By establishing a collaborative approach involving various stakeholders, the successful introduction and implementation of a digital decision can be realized, leading to positive and transformative changes in the city. Using blockchain technology (assuming the industry also has one), the transparency and fairness of the offline implementation can be achieved out of the box. Having the transactions publicly available, together with the decisions it can be seen that the money flow is honest and there is no nepotism in any public tender. After the realisation, the contractor should be made public, so that all the other stakeholders can held him accountable for the provided service, making sure that it will be done with the highest quality. Nevertheless, performing more analysis towards possible required laws and regulations might be necessary. Understanding also the size of the implementation team as well as whether it should be cross-domain or single one, can add additional data towards implementation and bring more ideas for more efficient implementation of city decisions.

Last but not least, in order for the full transparency of the solution, everything, from the scratch till the end should be public. It includes multiple points that were also mentioned throughout the research such as the budget. Understanding the city spendings can help in visualization of the potential improvements and any upcoming savings that can introduce new ideas within the city and improve the society. What is more, the decision about the chosen supplier, as well as the follow-up decision should be presented publicly, helding the people responsible for it accountable for their decision and ensuring that they are working for the society and not for their own benefit.

Nevertheless, it is necessary to evaluate proposed strategies and try to implement them in the real life situation. Combining the benefits of multiple strategies and even proposing new ones, can bring the future implementation of the blockchain technology closer to the reality and can ensure people that all of the aspects are well thought about.

6.9.4. Privacy and security of the people

Another important aspect in the potential limitations that hinder the blockchain implementation is privacy and security of the solution. On the one hand, citizens who participate in the decision-making process should not be revealed to the public, as that might create a threat for them. On the other hand, the people responsible for the given decisions, as well as the suppliers who are also performing tasks within the given decision would have to be publicly shown in order to held them accountable for all the pros and cons of their service. What is more, in order to ensure that the people's data is not leaked multiple security and encryption measures has to be implemented. Conducting regular audits, educating the audience and raising awareness about the risks and what to look for in the potential hacks and phishing emails is a necessary way of tackling the problem of security. Last but not least, essential encryption mechanisms and data protection protocols has to be taken in place to ensure safety and security in the platform.

Additionally, one other important aspect has to evaluated - ensuring that only people from the given city can provide their input to their city decisions and do not influence other municipalities. What is more, it is also important that other countries, especially the enemy ones will not negatively influence any decisions by registering their own users and providing the negative input to any of the decisions, blocking development of the city. In order to sufficiently combine both the privacy aspect as well as security one, whenever someone is registered in the given region, they should immediately obtain the appropriate username and password for the platform, with necessary role with access for the given city. When the person is moving to another city, the previous role should be revoked and role granting access to the new city should be provided. Increased security aspect should be in context of the both companies and municipality, which will have bigger priviliges, such as applying as a supplier for the given proposals or being a member of the main implementation team.

6.9.5. Scalability of the solution

With the cities having only 100 000 people, scalability of the solution is not a problem. On the other hand, bigger cities like London, New York and Tokyo has significantly higher population, that would require appropriate scalability considerations - not only from the technology perspective, but also from the information perspective. Starting with the technology solution, for the bigger cities such as Tokyo, which has around 37 million people living in (Tokyo, 2023), the scalability and appropriate consensus mechanisms would have to be taken in the blockchain technology. To approximate the need for the amount of transactions per second, few of the following approximations have been taken into account:

1. Only 5% of the people are actively participating in the decision-making process on the platform
2. Those people participate vote and provide their input within the similar hours - starting from 2pm to 10pm (8 hours)
3. People are ideally distributed during the time - there are no peaks during specific hours, but at every instant the same amount of people is providing their vote
4. They provide only 3 information (approval/disapproval/comment of the proposal in the city)

Based on those variables, the required number of transactions that the platform would have to withstand is 190 transactions per second (TPS)! However the provided parameters are giving the context of the required scale from the solution. Currently used most famous blockchains can provide only around 7 TPS, up to even 30 TPS (Monrat et al., 2019). What is more, the peaks of the people could even multiple the required number of transaction 10 times, making it even 1900 TPS. Both appropriate software implementation with a focus on scalability, as well as the appropriate consensus mechanism has to be chosen. One of the ways to solve it is building the platform using the similar approach as the Solana blockchain. It is claimed that it can solve the blockchain scalability problem and some of the tests verified that it can provide throughput of even 7000TPS (Pierro & Tonelli, 2022), with the possibility to scale even more. Even in the context of a bigger peaks that could happen immediately after the working hours, Solana blockchain should be able withstand the requirements and provide the highly available service to the users.

The future researchers are advised to further analysed the provided parameters above and establish their maximum values (which can differ depending on the city and country). Having those parameters, the scalability requirements of the technology and appropriate tests on the Solana (or maybe a different) blockchain can be performed to verify whether it can withstand the peaks.

From the information perspective bigger cities, especially capitals, can create significant number of proposals, starting even with the tens or hundreds per day. Citizens will not be able to review and verify all of them during their daily schedule, making it harder and harder to participate. Therefore the appropriate targeting, filtering and tagging mechanisms have to be implemented within the platform. Targeting mechanism would allow citizen to quickly get a glance on the most relevant proposals (for them) happening in the city. Both the analysis performed by the people responsible for the given proposal, but also Artificial Intelligence technologies can be utilized to provide the implications of those decisions. Those information can be provided to the filtering mechanisms, which would try to limit the amount of information presented to the citizens by providing them only the ones that are mostly related to them, making sure that they can immediately access potentially the most important proposals in their perspective. Last but not least, the tagging mechanisms which would allow to quickly search through the proposals with the given domain. It would allow people to find appropriate proposals for the domain that they are the most passionate and knowledgeable about. All of those mechanisms can help with providing the most important proposals for the citizen, ensuring that they will not waste many hours looking for the appropriate ones. Nevertheless, there are still many other ways that might improve the relevance of the information that is provided to the citizen, such as giving higher priority to the already vote proposals. Multiple mechanisms should be verified by the future researchers and the analysis of its effectiveness should be evaluated.

6.9.6. Environment and cost

Another aspect, that still needs further research is related to the environment and potential costs of the solution. Depending on the chosen consensus algorithms, different computers and servers will be required for the platform to be used. What is more, cities with more population would require higher throughput, therefore more and bigger servers would have to be bought than the ones that would be used in the smaller towns. Managing and maintaining such a solution would also require not only enormous money resources, but also people that are competent with the blockchain technology and server administration. Smaller cities that do not have so much money might be excluded from trying this technology in their region. However the usage of the new technologies allow everything to be shared. In order to provide such a platform to all the city, it would be possible that the infrastructure is shared between them - for instance within the country. The country will provide the necessary infrastructure for the cities to use and the resources could be pooled and used by different towns together. Such a solution would allow all the cities to participate in this blockchain program, while also making sure that there is no over or under provisioning of resources for the given city.

Nevertheless, it is important to take a look at the potential increase in energy consumption. If all the proposals were to move immediately to the digital world, number of servers would rise. What is more, in order to validate the transactions on the blockchain the consensus mechanisms would have to be used. Aforementioned Solana blockchain is using Proof of History consensus mechanism (Pierro & Tonelli, 2022), which is much more energy efficient than typical Proof of Work - which requires significant computing power. According to the main website of the Solana blockchain, on average one transaction is an equivalent of an energy usage of a half of a google search (Foundation, 2022). Nevertheless, this is publicly available blockchain that has almost 2000 of computers constantly running. It is important to understand that due to security perspective, the blockchain that would be used by the given country should be privately maintained and not available to all the other countries. Then the data center should be in the country of its usage (also from the regulations perspective) and make sure that it is highly available. On the one hand, there should be more research about the increased energy needs by the different countries to ensure that it could be sufficiently satisfied with the green energy. On the other hand, daily usage of the platform should not create any environmental problems especially with Solana small energy consumption cost. Doing the research on the current city consumption and combined consumption of the potential solution would bring more realistic view for the given country. Providing the key parameters that have been gained during the research process, so that the other countries could also be evaluated can bring a lot of benefits in the global scale environmental analysis of the blockchain solution.

6.10. Management of Technology Master Program Relation

The research uses multiple concepts learned during the Management of Technology program to thoroughly perform the study. It examines the utilization of blockchain, a highly advanced technology for solving real-world problems. The research emphasizes the importance of aligning various stakeholder groups to achieve optimal solutions, particularly within multiple-actor networks. It also evaluates diverse aspects of blockchain technology, going beyond hardware and software considerations to address concerns like privacy and environmental impact. The thesis critically analyzes the potential adoption and implementation of blockchain by policymakers and industry, emphasizing the need for accountability and transparency. Additionally, it explores the impact and enhancements that new technologies bring to existing processes, both in companies and municipalities. It also considers other innovative ways of sharing information and city proposals to effectively reach and engage the community. The study acknowledges the current limitations of blockchain technology and highlights the necessity for further research and technological readiness before its widespread application. Last but not least, research design has been prepared encompassing both quantitative and qualitative data analysis. The study also reflects on its limitations to inform future researchers about potential drawbacks, as well as provides the reflection on the found problems, guiding the future research in this area.

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A

Survey Figures

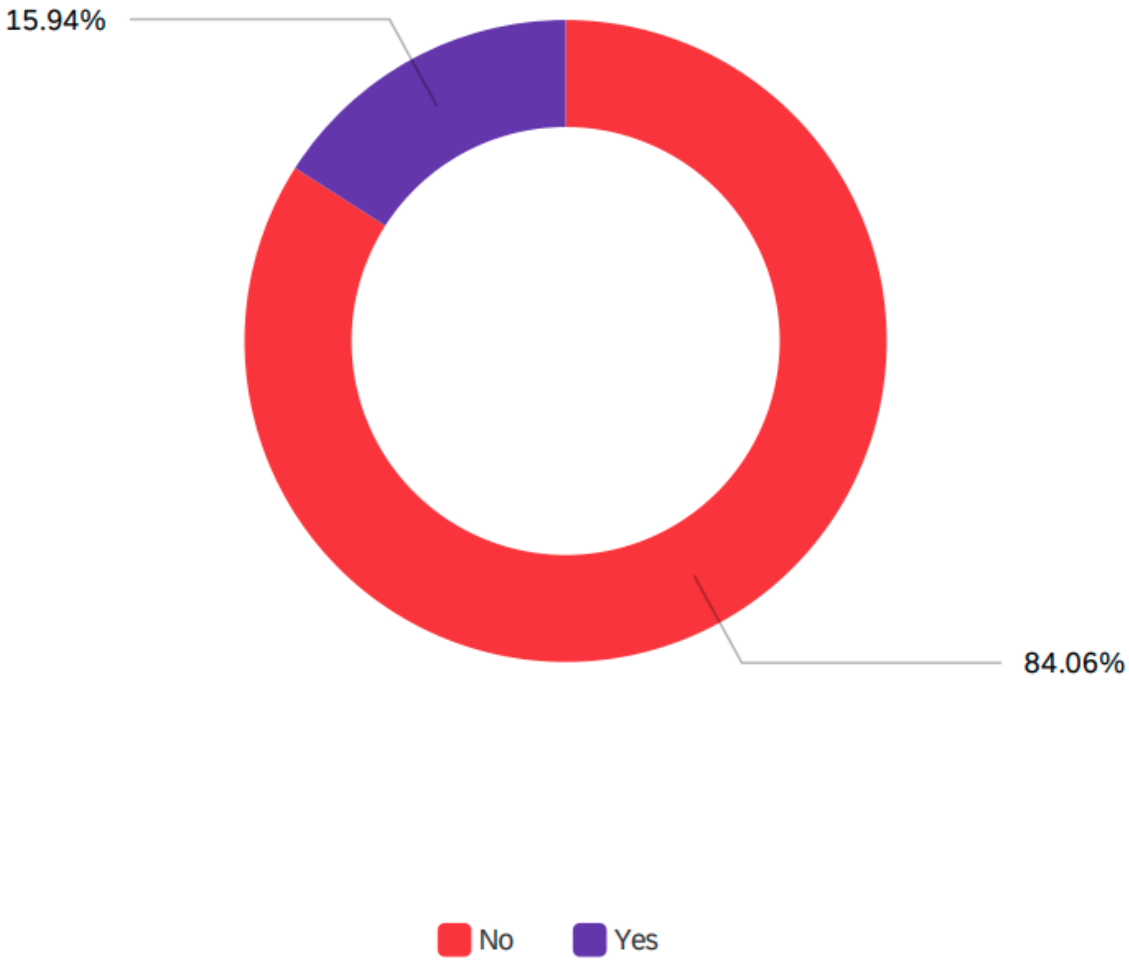

Figure A.1: Pie chart of the people aware of the decision making process

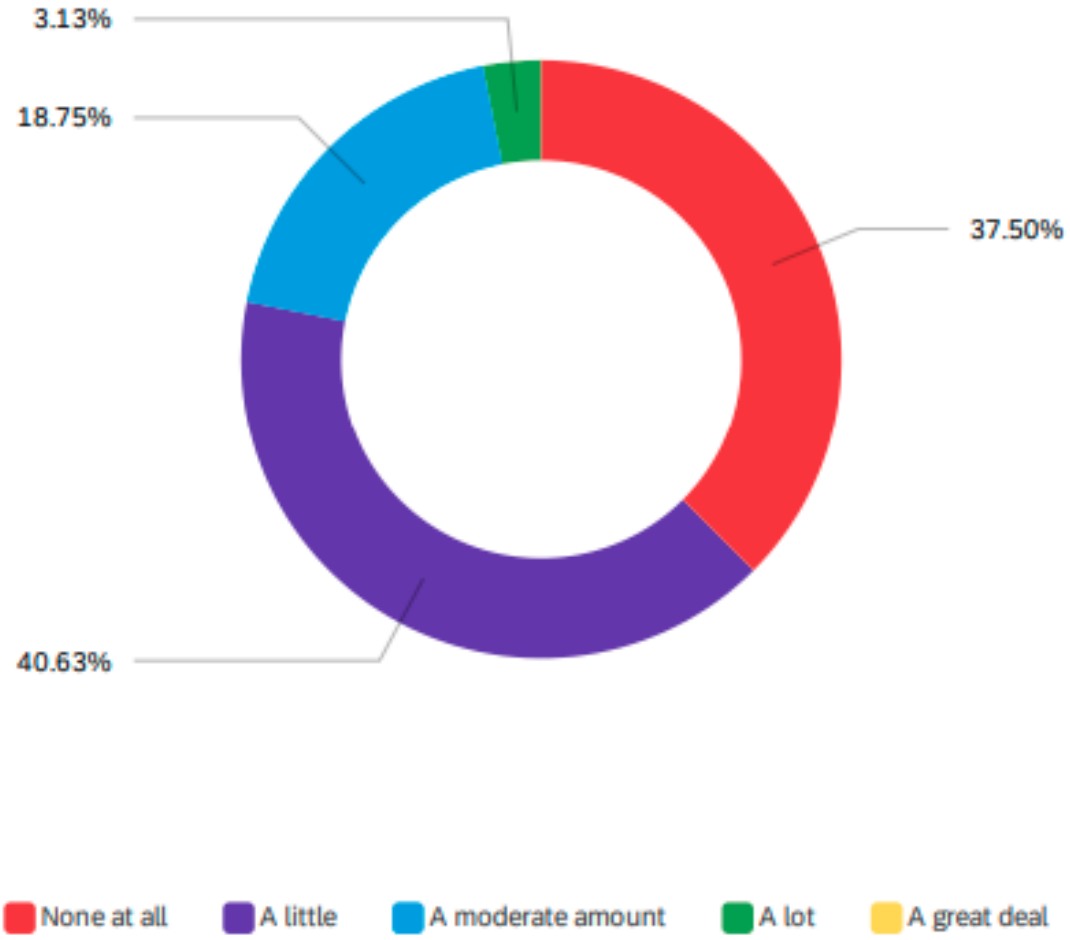

Figure A.2: How informed people feel about the decision making process in Delft

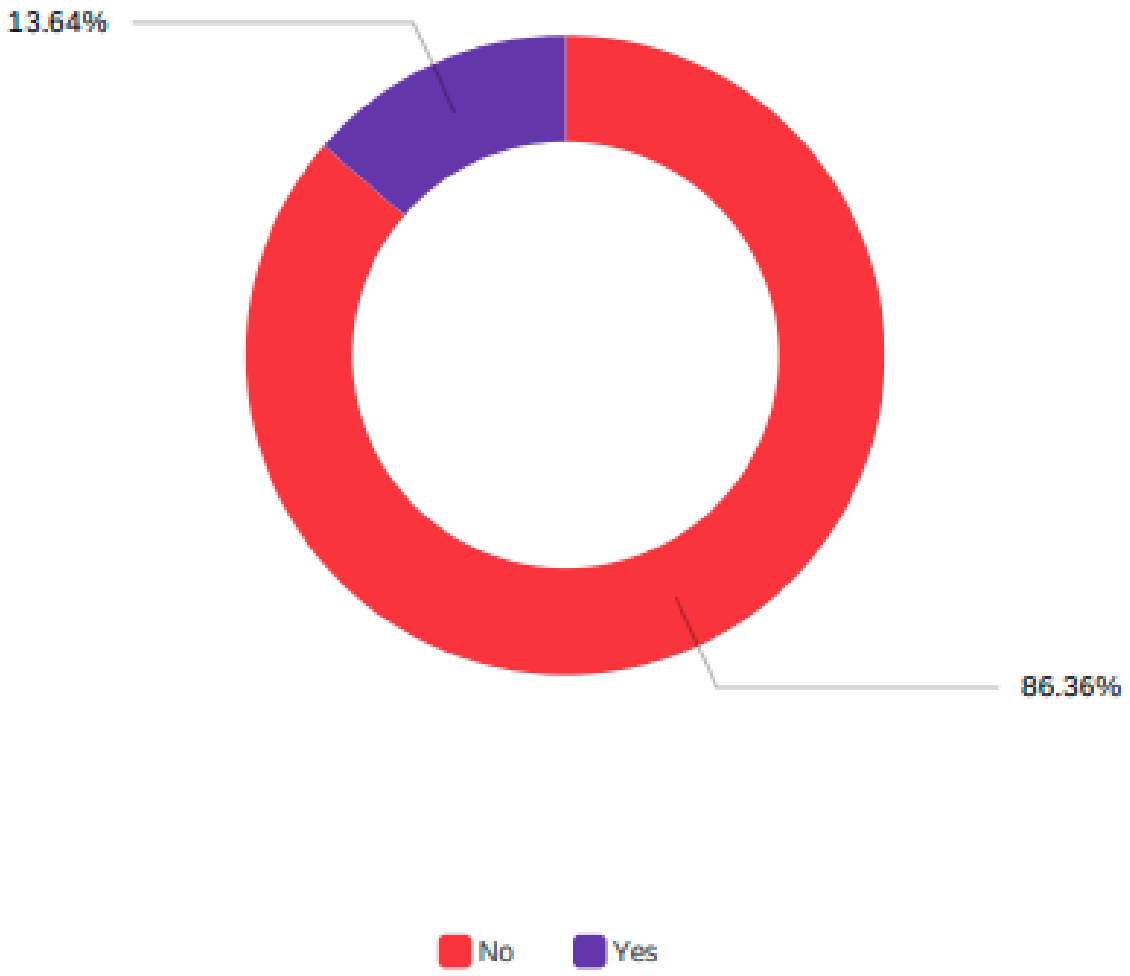

Figure A.3: Do people know about opportunities for public participation?

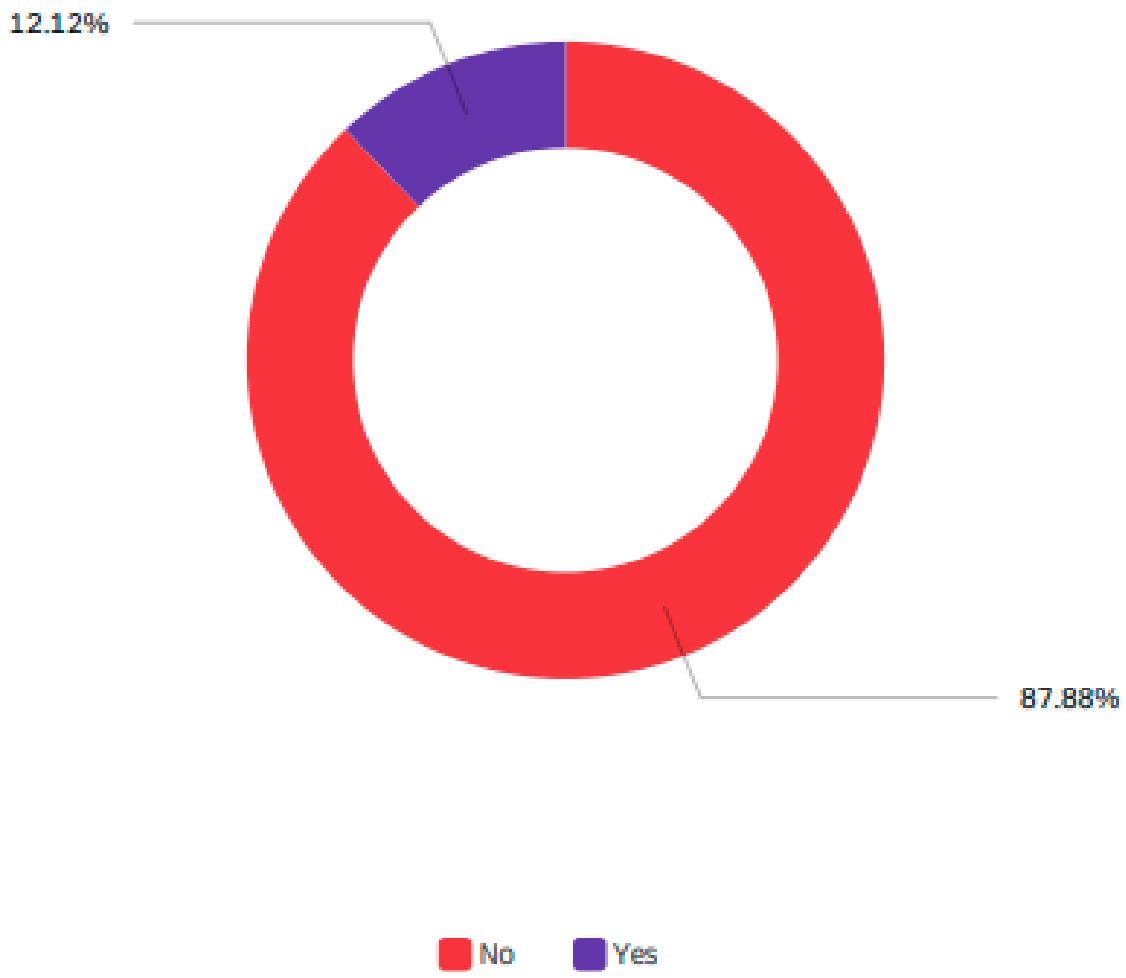

Figure A.4: Do people know how to provide feedback?

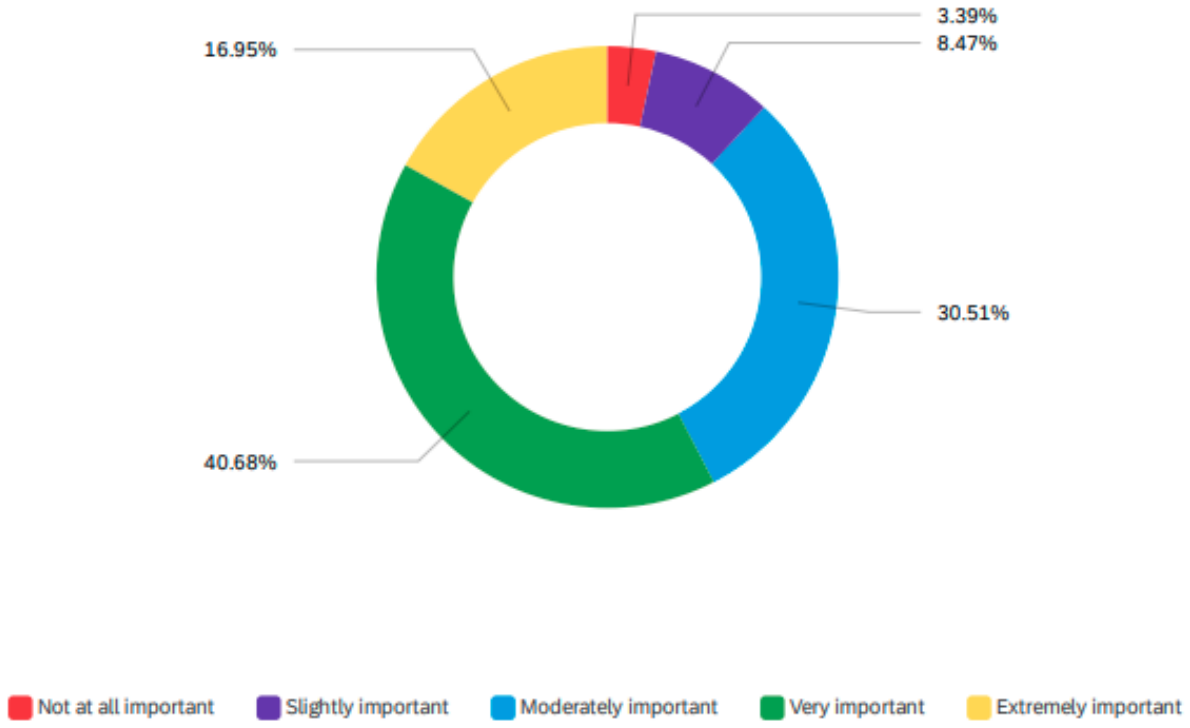

Figure A.5: How important is transparency and accountability for people?

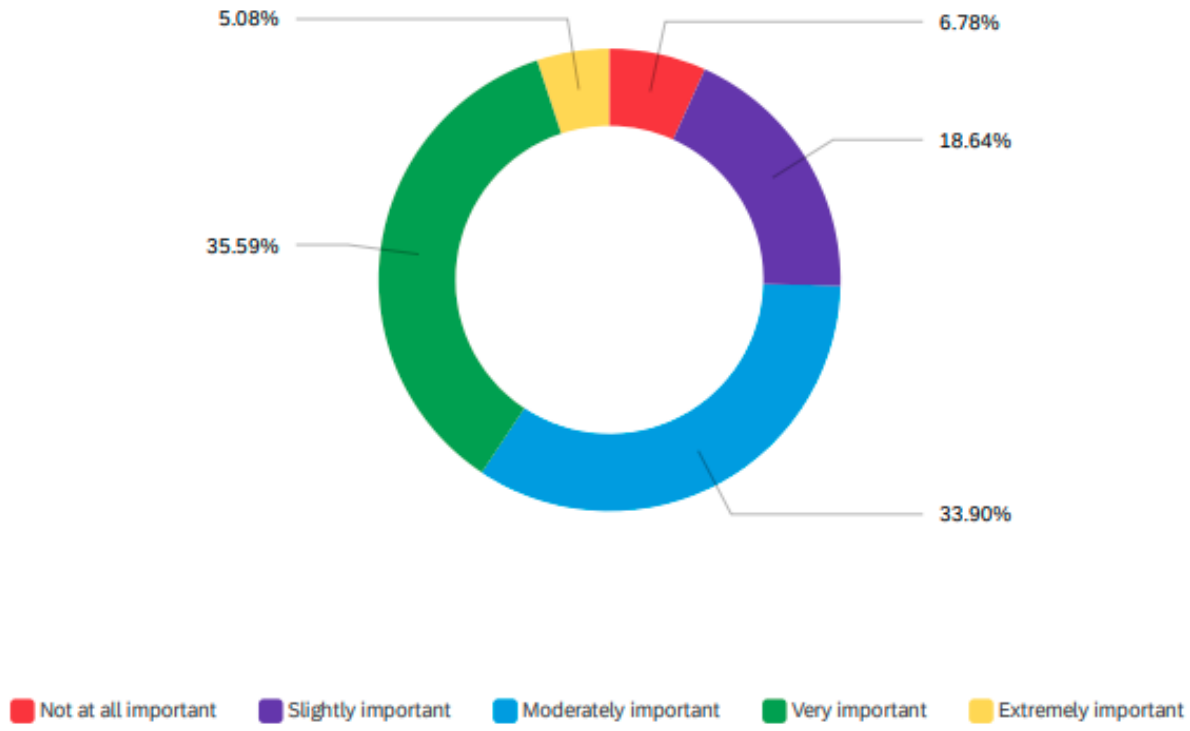

Figure A.6: How important is ease of participation for people?

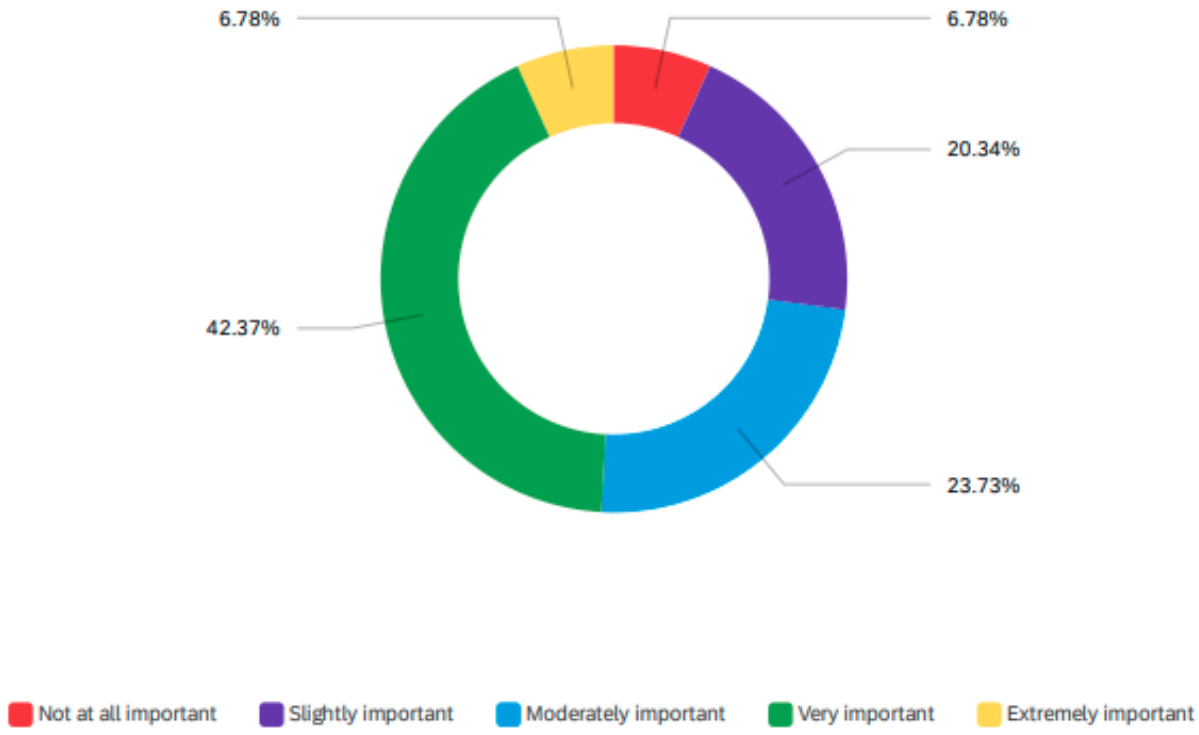

Figure A.7: How important is being informed about the decision made in the city?

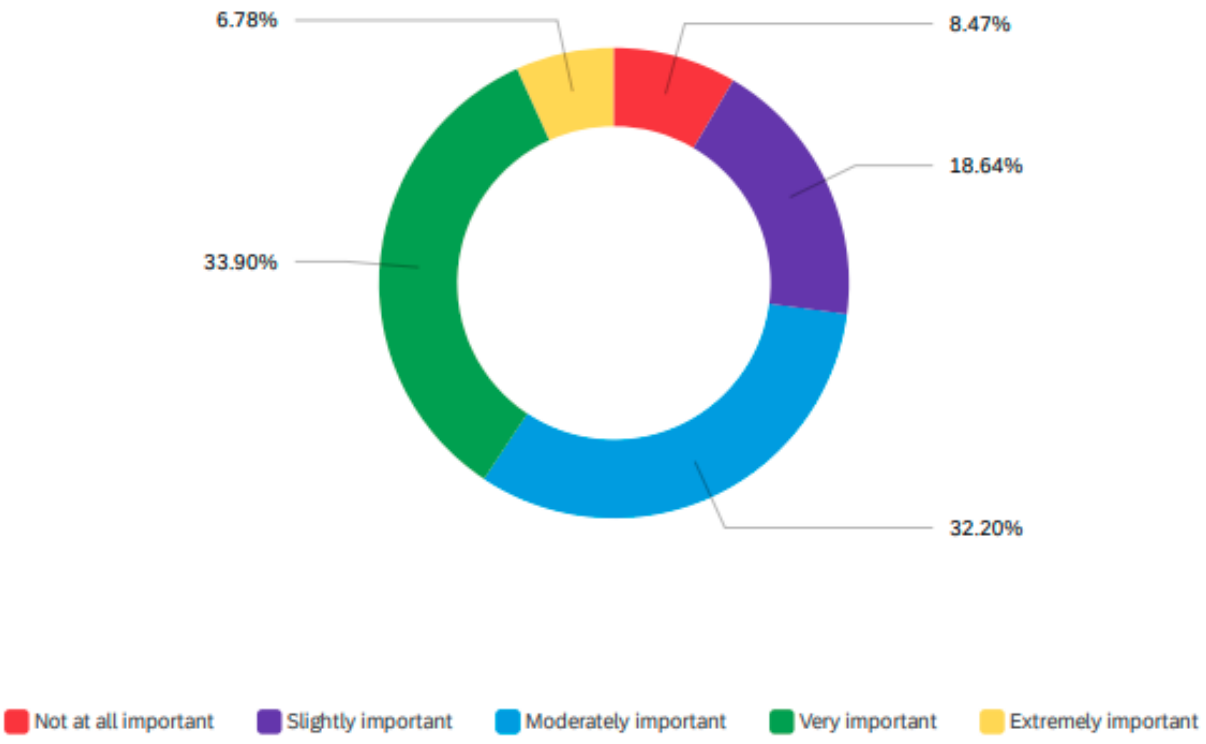

Figure A.8: How important is providing anonymous feedback about the decisions made in the city?